LOWER DEVONIAN (PRAGIAN–EMSIAN) STROMATOPOROIDS FROM VICTORIA

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The Lower Devonian (Pragian–Emsian) stromatoporoid faunas of Victoria are described. The diverse assemblages include much of the material used in the original descriptions of Elizabeth Ripper in the 1930s supplemented by new collections from the most fossiliferous successions. Altogether 37 species represent 23 genera of stromatoporoids. New species are the clathrodictyids *Atelodictyon hicksense* and *Clathrodictyon? heathsense*, the stromatoporellid *Amnestostroma holmesae*, the stromatoporids *Parallelopora ampla, Habrostroma tyersense* and *Columnostroma clathratum*, and the amphiporid *Stellopora porrecta. Plectostroma, Petridiostroma, Stictostroma, Tubuliporella, Syringostromella, Coenostroma* and *Columnostroma* are recorded from Australia for the first time. The microstructures of the best preserved specimens are also described and illustrated.

The assemblages represent three biostratigraphically distinct assemblages: (i) the lower–mid Pragian (*sulcatus* to *kindlei* conodont biozones) association of the Lilydale Limestone at Lilydale and the Coopers Creek Limestone near Tyers, which include key elements such as *Plectostroma altum, Aculatostroma*? sp., *Schistodictyon? cylindriferum, Pseudoactinodictyon* sp., *Atelodictyon chapmani, Stromatoporella* cf. *granulata, Tubuliporella calamosa, Amnestostroma holmesae, Salairella lilydalensis, Syringostromella zintchenkovi, Habrostroma tyersense, Columnostroma clathratum* and *Dendrostroma*? sp.; (ii) the basal Emsian (*deliscens* conodont Biozone) association in the Buchan Caves Limestone of the Buchan district with restricted elements such as *Clathrodictyon? heathsense, Pseudotrupetostroma buchanense* (and possibly *P. rippcrae*), *Syringostromella* cf. *labyrinthea, Coenostroma* sp. and *Atopostroma distans*; and (iii) the lower–mid Emsian (*perbonus* conodont Biozone) association of the upper Murrindal Limestone of the Buchan area with key elements such as *Petridiostroma delicatulum, Pseudotrupetostroma* sp., *Parallelopora ampla* and *Atopostroma* sp.

The biostratigraphically well-constrained Pragian–lower Emsian assemblages of Victoria exhibit many genera, such as *Pseudoactinodictyon, Stromatoporella, Stictostroma, Tubuliporella, Parallelopora, Pseudotrupetostroma* and *Coenostroma*, which are more characteristic of Middle rather than Lower Devonian successions in many parts of Asia, Europe and North America. These occurrences indicate that all these forms have significant Lower Devonian records, at least locally. A brief review of the significant features of the Australian Devonian stromatoporoid faunal record is presented, as well as an outline of the global Lower Devonian succession of stromatoporoid faunas.

STROMATOPOROIDS were first noted as occurring in Siluro-Devonian successions of Victoria by Chapman (1912a, 1912b, 1913, 1914), but it was Elizabeth Ripper who first contributed significantly to the knowledge of the Victorian Devonian assemblages. Her work was published in a series of pioneering papers by the Royal Society of Victoria during the 1930s, based on material from a number of limestone bodies, most notably from Lilydale and Loyola (Fig. 1) in central Victoria (Ripper 1933, 1937a, 1937b), and from the Buchan district of eastern Victoria (Ripper 1937c). She recognized the Lilydale stromatoporoids as including a high percentage of forms characteristic of the Lower Devonian, a much smaller Loyola assemblage of possibly older (maybe Silurian) elements, and the varied Buchan faunas as having a mainly 'Middle Devonian' aspect (Ripper 1938). She also attempted a full analysis of the evolutionary relationships of the Victorian faunas, especially in the context of other known Silurian and Devonian associations in Europe and North America.

STRATIGRAPHIC SETTING

The Lilydale Limestone was described by Crohn (1953) as a 220 m thick, steeply dipping, lenticular mass within a sequence of interbedded

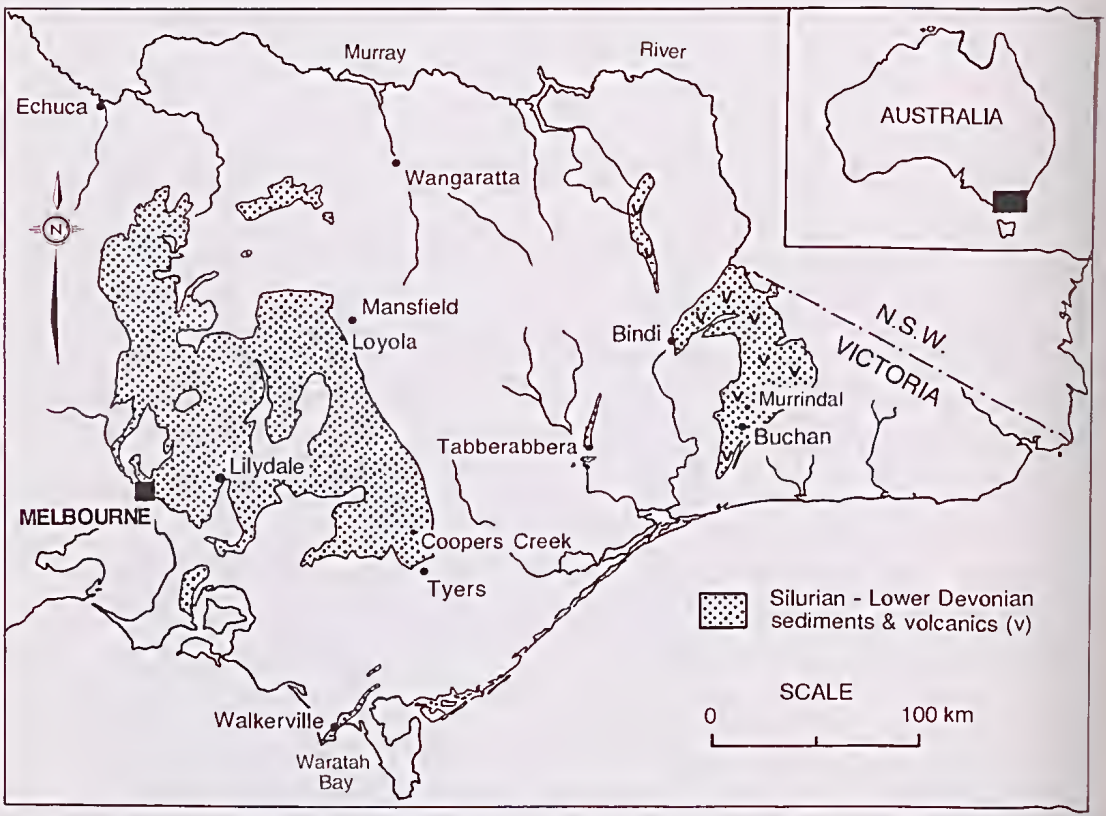


Fig. 1. Map of central and eastern Victoria showing the general outcrop areas of Silurian–Lower Devonian sequences, and the locations of the main Lower Devonian (Pragian–lower Emsian) stromatoporoid-bearing limestones.

shales and sandstones at the Cave Hill quarry site, 1.3 km south-west of Lilydale township. Crohn established its stratigraphic relationships as being underlain, seemingly with conformity, by a great thickness of Humevale Siltstone (= Ruddock Siltstone), and overlain unconformably by a 'quartzite' unit (the Cave Hill Sandstone of VandenBerg 1971). VandenBerg (1971) first considered the Lilydale Limestone to be too limited in extent to warrant formation status. He regarded it as a limestone member in the uppermost part of the Humevale Siltstone. Later, VandenBerg (1975) reinterpreted the limestone body as an allochthonous lens ('a large megaclast') in the shales and included it with the overlying sandstones in a redefined 'conformable' Cave Hill Formation. However, after excavation of the site and exposure of the angular unconformity between the Lilydale Limestone and the overlying Cave Hill Sandstone, VandenBerg (1988: 111) adopted the original interpretation of Crohn (1953).

The very thick (3700 m) succession of Humevale Siltstone underlying the Lilydale Limestone contains four separate brachiopod assemblage zones which apparently span the entire upper Ludlow through Přídolí to Lochkovian interval (Garratt 1983, Garratt & Wright 1988). The diverse Lilydale Limestone faunas (locality 6 of Gill 1940, fig. 1) were listed as including 18 species of stromatoporoids, 9 tabulates, 8 rugosans, a varied gastropod and bivalve fauna and a rich conodont assemblage. VandenBerg (1971) referred to the stromatoporoids as having the appearance of boulders in the detrital-biostromal limestones. The rugose corals were described by Hill (1939). Philip & Pedder (1967) recorded the conodont zonal index *Eognathodus sulcatus*, indicating an early Pragian age (Oliver & Chlupáč 1991) for the Lilydale Limestone (Fig. 2).

The concept of the local Victorian stratigraphic subdivision Yering Series of Gregory (1903), or 'Yeringian', was based on the strata in

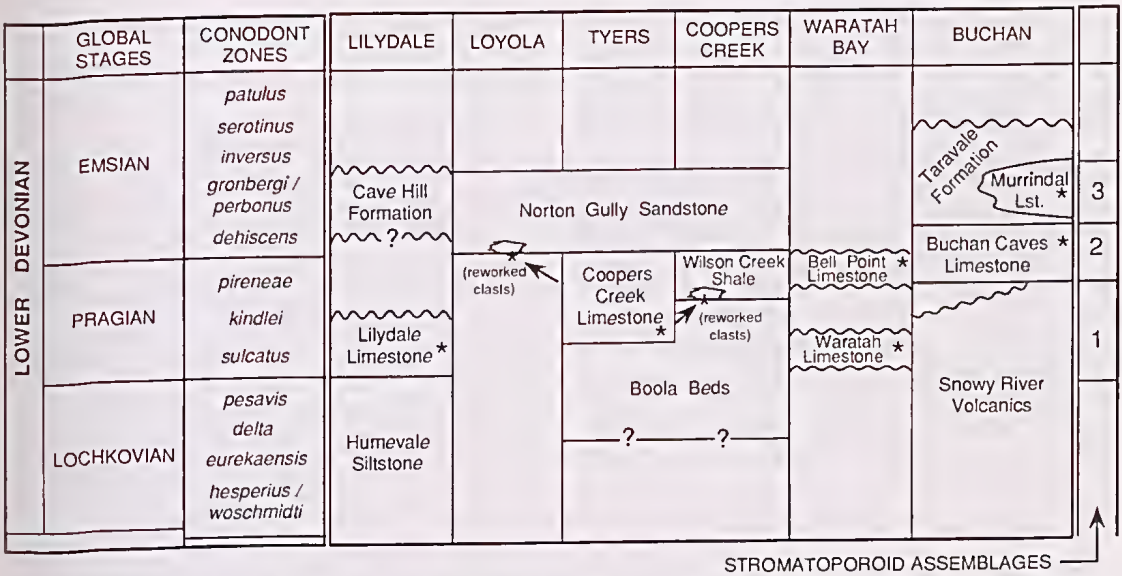


Fig. 2. Stratigraphic chart to show the age relations of the main stromatoporoid-bearing units in the Lower Devonian sequences of Victoria (after VandenBerg 1988; Mawson 1987; Mawson et al. 1988, 1992). The main stratigraphically distinct Pragian–lower Emsian assemblages (1–3) are shown in the the right column. Asterisks denote stromatoporoid horizons or occurrences referred to in the text. Arrows suggest possible sources of reworked stromatoporoid-bearing clasts.

the Lilydale district and apparently included most of what is now Humevale Siltstone, Lilydale Limestone and Cave Hill Sandstone. This sequence was viewed until the 1930s as having a Silurian (Wenlock to Ludlow) age, but the palaeontological and stratigraphic work into the 1940s led to reassignment of the whole (Gill 1942), or of the upper part only, to the Lower Devonian (for discussion see Philip 1960). The Yeringian, and names such as the Yering Beds of Gill (1942) and the Yering Group of Talent (1965) and Talent & Banks (1967), this latter comprising the Ruddock Siltstone and the Lilydale Limestone, have fallen into disuse.

When Ripper worked on the faunas of the Lilydale Limestone, however, the term 'Yeringian' was still much used. In her earliest (1933) paper she referred to the Lilydale stromatoporoid occurrences as 'Silurian (Yeringian)', but later (1937c) argued that a higher proportion of the species were more identifiable with the Devonian than with the Silurian, and in her 1938 paper she viewed the 'Yeringian' fauna of Lilydale as characteristic of the Lower Devonian.

Gill's (1942) assignment of the entire 'Yeringian' to the Lower Devonian was too restrictive for, as we now know, the sequence of Humevale Siltstone to Cave Hill Sandstone, inclusive, spans a very large time interval, comprising much of the Late Silurian (late Ludlow) to Early Devonian (Emsian). Since 1960 the local stage subdivisions for the Silurian and Devonian have progressively been abandoned in favour of using internationally adopted and accepted nomenclature (Talent et al. 1975).

Conaghan et al. (1976: 529) and VandenBerg (1988) referred to the limestones at Loyola, near Mansfield, as allochthonous lenses within the Norton Gully Sandstone (Fig. 2). Conodonts from these bodies include *Polygnathus pireneae* and *Ozarkodina buchanensis*, which suggested to Mawson (1987: 284) the *kindlei* or to Mawson et al. (1988) the *pireneae* biozones of middle or late Pragian age. The matrix of the Norton Gully Sandstone is regarded by VandenBerg (1988, table 4.1) as younger, equating with the Cave Hill Sandstone and of probable Emsian age. Stromatoporoids have been collected from the limestone lenses exposed at Griffith's Quarry (Ripper 1937a) and Lime Kiln Quarry, Loyola (see map of Cooper 1973, fig. 1).

In the Tyers area, the Lower Devonian sequence includes, in ascending stratigraphic order, the Boola Beds (= Formation), the Coopers Creek Limestone and the sandy Walhalla Beds (Norton Gully Sandstone equivalents). The biotas through the Boola Beds to

Coopers Creek interval are richly diverse and have been documented partly by Philip (1962). A varied coral, stromatoporoid and conodont fauna has been recorded from many localities (and horizons) in the Coopers Creek Limestone, including fossil locality no. 11 of Philip (1962, fig. 1) at Tyers Quarry, the type locality of the conodont *Eognathodus sulcatus* Philip, 1965, which characterises the early Pragian *sulcatus* Biozone, though the section in the quarry extends upwards into the overlying mid-Pragian *kindlei* Biozone (Mawson & Talent in press). Philip (1962) listed a total of 19 stromatoporoid species from various localities (and horizons) in the Cooper Creek Limestone of the Tyers area, some possibly from higher stratigraphic levels, namely within the late Pragian *pireneae* to earliest Emsian *dehiscens* zonal interval (Mawson & Talent in press). However, none of these was described subsequently, and few have been confirmed in existing collections. The present survey focused on stromatoporoids from levels in the upper *sulcatus* to lower *kindlei* interval at Tyers Quarry, and from the Evans Quarry limestone megaclast of *kindlei* age near the former settlement of Coopers Creek (Figs 2–3).

Philip (1960) first recorded occurrences of Devonian stromatoporoids from the Bell Point Limestone at Waratah Bay. The Lower Devonian succession in this area comprises the Waratah Limestone unconformably overlain by the Bell Point Limestone (Talent 1965). The Waratah Limestone contains a moderately varied coral fauna and the conodont *Eognathodus sulcatus* (Fig. 2), suggesting correlation with the Lilydale Limestone and the lower part of the Coopers Creek Limestone (Philip & Pedder 1967, Garratt 1983, Mawson & Talent in press). Mawson et al. (1988: 496) placed almost the entire Waratah Limestone within the *sulcatus* Biozone. The overlying Bell Point Limestone has not yielded diagnostic conodonts though it has a rich macrofauna. Like the Buchan Caves Limestone, it has representatives of the *Spinella–Buchanathyris* brachiopod assemblage zone (Garratt & Wright 1988), probably suggesting correlation with lower Emsian levels. However, it may be better aligned with the lower part of the Buchan Caves Limestone, that is, equating with the late Pragian *pireneae* Biozone (J. A. Talent, pers. comm.). In the present work stromatoporoids have been collected from the Waratah Limestone, and the '*Amphipora*' beds of the Bell Point Limestone has been sampled along the coast near Walkerville (Fig. 3). Philip (1960: 153) listed a number of species additional to '*Amphipora*' (= *Stellopora*) from the Bell Point Limestone but these have not been verified in our collections or in those of the Museum of Victoria.

In the Buchan area of eastern Victoria, the Buchan Caves Limestone is in excess of 200 m thick and has a mainly sheet-like configuration, though Talent (1988) recorded a coral–stromatoporoid rich buildup in the upper part at Heath's Quarry, and another seemingly low in the formation (J. A. Talent, pers. comm.) at Martin Cameron's Quarry. The Buchan Caves Limestone is succeeded by approximately 700 m of mudstones and nodular limestones of the Taravale Formation, which intertongues into the wedge-shaped body of the Murrindal Limestone, itself up to 250 m thick (Teichert & Talent 1958; Talent 1965, 1969), and with an associated coral–stromatoporoid buildup (a carbonate 'mud-mound') at Rocky Camp between Buchan and Murrindal. These units, together forming the Buchan Group, exhibit a rich and varied biota (Teichert & Talent 1958).

Mawson (1987) established a polygnathid-based conodont zonal succession through these deposits, especially within the Taravale Formation. The lower part of the Buchan Caves Limestone is poorly fossiliferous and dolomitic, with the more diverse faunas limited to the upper part of the formation (Mawson et al. 1992). The Heath's Quarry buildup is considered to have formed in the upper Buchan Caves Limestone. No conodonts have been found in these massive coral–stromatoporoid–'algal' deposits. However, based on conodont data from the immediately overlying Taravale Formation, Mawson et al. (1992: 37) have inferred that construction continued from the time of the *dehiscens* Biozone until about the beginning of the *perbonus* Biozone.

The *perbonus* Biozone is recorded through the middle part of the Taravale Formation and the upper part of the Murrindal Limestone (including the Rocky Camp buildup). The *dehiscens* and *perbonus* biozones approximately span the lower Emsian (or Zlichovian) interval. The *inversus* and *serotinus* biozones have been discriminated in the upper Taravale Formation, but not the uppermost Emsian *patulus* Biozone (Fig. 2).

The stromatoporoids documented by Ripper (1937c) come mainly from two lower Emsian horizons: (1) within the Buchan Caves Limestone (Heath's Quarry, Martin Cameron's Quarry, Citadel Rocks, Murrindal River and probably the locality near Hicks's (now Robert

Global Stages	Pragian						Lower Emsian						
Conodont Zones	*sulcatus*			*kindlei-pireneae*			*dehiscens*					*perbonus*	
Formations & Localities / SPECIES	Lilydale Lst. (Lilydale)	Waratah Lst. (Walkerville)	Coopers Creek Lst. (Tyers Quarry)	Lst. megaclast (Evans Quarry)	Loyola Lst. ('Griffith's Qu.,[2] Lime Kiln Qu.)	Bell Point Lst. (Walkerville)	Buchan Caves Limestone: Heath's Quarry	Martin Cameron's Quarry	Near Hicks'	Citadel Rocks	?Buchan Caves Lst. (Bindi)	Murrindal Limestone (L4 roadside)	Murrindal Lst. (Rocky Camp Quarry)
ACTINOSTROMATIDA													
Actinostroma compactum	X						X	X					X
Actinostroma sp.		X											
Plectostroma altum	X		X										
Aculatostroma? sp.	X	?X											
CLATHRODICTYIDA													
Gerronostroma buchanense							X		X				X
Petridiostroma clarum									X				X
Petridiostroma delicatulum													X
Petridiostroma sp.					X[1]								
Clathrodictyon sp.								X					
Clathrodictyon? heathsense sp. nov.							X		X[aff.]			X[cf.]	
Schistodictyon? cylindriferum	X												
Pseudoactinodictyon sp.			X										
Atelodictyon chapmani	X				?X[1]								
Atelodictyon hicksense sp. nov.									X				X
Atelodictyon sp.											X		
STROMATOPORELLIDA													
Stromatoporella cf. *granulata*	X				?X[2]								
Stictostroma sp.												X	X
Tubuliporella calamosa	X												
Dendrostroma? sp.	X												
Amnestostroma holmesae sp. nov.	X		X										
STROMATOPORIDA													
Pseudotrupetostroma ripperae	?X						X						
Pseudotrupetostroma buchanense									X				
Pseudotrupetostroma sp.													X
Salairella lilydalensis	X		X										
Stromatopora aff. *polaris*							X[3]	X	X	X			X
Stromatopora sp.	X												
Syringostromella zintchenkovi	X												
Syringostromella cf. *labyrinthea*							X[3]			X			
Parallelopora ampla sp. nov.													X
Coenostroma sp.							X						
Habrostroma tyersense sp. nov.	X	?X	X	?X									
Habrostroma sp.													X
Atopostroma distans							X						
Atopostroma sp.													X
Columnostroma clathratum sp. nov.	X												
AMPHIPORIDA													
Stellopora porrecta sp. nov.						X							

Fig. 3. Distribution of the stromatoporoid occurrences in the Pragian to lower Emsian limestone successions of Victoria. The two localities (Griffith's and Lime Kiln quarries) in the Loyola Limestone have different species denoted by superscripts 1 and 2 respectively. Two of the species listed from the Buchan Caves Limestone at Heath's Quarry occur also in the Buchan Caves Limestone at Citadel Rocks, Murrindal River, and are represented on the Heath's Quarry column by addition of superscript 3. *Clathrodictyon*? aff. *heathsense* occurs near Hicks's and *C.*? cf. *heathsense* at the L4 roadside locality near Murrindal.

McRae's property, see Mawson 1987, text-fig. 5)), of *dehiscens* age; and (2) from the Murrindal Limestone (Rocky Camp Quarry) of *perbonus* age. We have added another locality (L4) from the Murrindal Limestone (latest *dehiscens* or early *perbonus* horizon) on the roadside 1 km south of Murrindal School.

DISTRIBUTION OF STROMATOPOROIDS AND BIOSTRATIGRAPHIC RELATIONSHIPS

The Early Devonian stromatoporoids of central and eastern Victoria belong to three biostratigraphically distinct Pragian–Lower Emsian assemblages (Fig. 2). Stromatoporoid assemblage 1 is best represented by the associations in the Lilydale Limestone and Waratah Limestone, of early Pragian age, and the occurrences in the Coopers Creek Limestone at Tyers Quarry, of early–mid Pragian age. The most diverse association is in the Lilydale Limestone at Lilydale, including *Actinostroma compactum*, **Plectostroma altum*, **Aculatostroma*? sp., **Schistodictyon*? *cylindriferum*, **Atelodictyon chapmani*, **Stromatatoporella*? *granulata*, **Tubuliporella calamosa*, **Dendrostroma*? sp., **Amnestostroma holmesae*, **Salairella lilydalensis*, *Stromatopora* sp., **Syringostromella zintchenkovi*, **Habrostroma tyersense*, **Columnostroma clathratum* and possibly *Pseudotrupetostroma ripperae*. The Waratah Limestone at the old lime kilns site at Walkerville South, on Waratah Bay, has a more restricted fauna comprising *Actinostroma* sp., possibly *Aculatostroma*? sp. and *Habrostroma tyersense*? The Coopers Creek Limestone at Tyers Quarry includes **Plectostroma altum*, **Pseudoactinodictyon* sp., **Amnestostroma holmesae*, *Salairella lilydalensis*, and **Habrostroma tyersense*. The key (restricted) elements of this early–mid Pragian faunal assemblage are indicated by asterisks.

These early–mid Pragian occurrences come from shallow-water carbonates that formed on the eastern (those at Tyers and Waratah Bay) and western (those at Lilydale) flanks of the Melbourne Trough (Garratt 1983, fig. 13), now interpreted as part of the Melbourne–Mathinna terrane of Glen et al. (1992). Significantly, Garratt (1983) regarded the stromatoporoids as members of his shallowest '*Favosites–Stromatopora* Community'.

Additionally, allochthonous limestone deposits on the western flanks of the Melbourne Trough exhibit a few reworked Pragian stromatoporoids, most notably at Coopers Creek and at Loyola (Fig. 1). A limestone megaclast at Evans Quarry near Coopers Creek has yielded *Habrostroma tyersense*? of probable mid-Pragian age, and the allochthonous Loyola Limestone bodies include late Pragian occurrences of *Peridiostroma* sp. and *Atelodictyon chapmani*? (Griffith's Quarry), and *Stromatoporella* cf. *granulata*? (Lime Kiln Quarry).

The Bell Point Limestone at Waratah Bay is possibly of similar late Pragian age and exhibits abundant specimens of the amphiporid *Stellopora porrecta*.

Early Emsian stromatoporoid assemblages are mainly restricted to eastern Victoria, especially in the Buchan Caves Limestone and the overlying Murrindal Limestone of the Buchan area (Figs 2–3). Stromatoporoid assemblage 2 of earliest Emsian (*dehiscens* conodont Biozone) age is best represented in the Heath's Quarry buildup, with *Actinostroma compactum*, *Gerronostroma buchanense*, **Clathrodictyon*? *heathsense*, *Pseudotrupetostroma ripperae*, *Stromatopora* aff. *polaris*, **Syringostromella* cf. *labyrinthea*, **Coenostroma* sp. and **Atopostroma distans*. Slightly modified and less diverse associations are represented at other localities in the Buchan Caves Limestone (see Fig. 2), notably from Martin Cameron's Quarry, from near Hicks's, Murrindal, and at the Citadel Rocks. Another possible Buchan Caves Limestone occurrence is at Bindi, where *Atelodictyon* sp. has been recorded. The restricted elements of this basal Emsian 'Buchan Caves' assemblage are indicated above with asterisks, with the possible addition of *Pseudotrupetostroma buchanense* (recorded only from near Hicks's).

Stromatoporoid assemblage 3 occurs in the overlying Murrindal Limestone, and is of early–middle Emsian (*perbonus* conodont Biozone) age. It is best characterized in the Rocky Camp Quarry exposures of the Buchan area (Fig. 3). *Actinostroma compactum*, *Gerronostroma buchanense*, *Petridiostroma clarum*, **P. delicatulum*, *Atelodictyon hicksense*, **Stictostroma* sp., **Pseudotrupetostroma* sp., **Parallelopora ampla*, *Stromatopora* aff. *polaris*, *Habrostroma* sp. and **Atopostroma* sp. are recorded. Roadside locality 4 near Murrindal School includes **Stictostroma* sp. and *Clathrodictyon*? cf. *heathsense*. Key elements of this fauna are indicated by asterisks.

OTHER SIGNIFICANT AUSTRALIAN DEVONIAN STROMATOPOROID OCCURRENCES

The reworked Early Devonian stromatoporoid fauna from the Jesse Limestone of central New South Wales (Webby & Zhen 1993) includes a number of species common in Victorian successions. For example, *Actinostroma compactum, Pseudotrupetostroma ripperae* and *Atopostroma distans*, constituting about one-quarter of the total Jesse fauna, are also recorded from the Buchan Caves Limestone at Heath's Quarry and assigned a probable *dehiscens* age. This accords with the interpretation of Webby & Zhen (1993) that some of the clasts in the allochthonous Jesse Limestone have an early Emsian (*dehiscens* Biozone) age. However, it is also possible that a few reworked elements may be slightly younger in age; for instance, *Pseudotrupetostroma jessiense*, except for slightly wider spacing of laminae, is closely similar to *P.* sp. from the Murrindal Limestone at Rocky Camp Quarry, of early–mid Emsian (*perbonus* conodont Biozone) age. Few other Lower Devonian stromatoporoid sequences from eastern Australia are as yet adequately enough known to allow close comparisons.

In the Broken River Embayment of north Queensland a remarkably complete sequence of limestones exists through the Late Silurian (Wenlock to Přídolí) to earliest Late Devonian (earliest Frasnian) interval, and within these units there is a remarkably diverse assemblage of stromatoporoids. This large fauna including more than 40 taxa is presently under description. In the Jack Limestone (Graveyard Creek Group), which straddles the Přídolí–Lochkovian boundary, there are representatives of *Ecclimadictyon, Plexodictyon, Schistodictyon, Syringostromella, Clavidictyon* and *Amphipora*. Higher in the succession, probably spanning the Lochkovian–Pragian boundary (*pesavis* to *sulcatus* conodont biozones), is the Martins Well Limestone Member (Shield Creek Formation), with an assemblage including *Labechiella, Cystostroma, Actinostroma compactum, Syringostromella, Atopostroma* cf. *distans, A.* sp., and *Habrostroma*. A gap in the sequence means that the next part of the record is missing, but a very rich assemblage follows in the Lomandra Limestone (lower part of the Broken River Group), of late Emsian to early Eifelian age. This unit includes *Rosenella, Stylostroma, Actinostroma, Gerronostroma, Atelodictyon, Stromatoporella, Pseudoactinodictyon, Simplexodictyon, Pseudotrupetostroma* and *Atopostroma*. The overlying Dosey Limestone spans the upper Eifelian to lower Givetian (*ensensis* conodont Biozone) and contains representatives of *Gerronostroma, Anostylostroma, Parallelopora* and *Salairella*. The Dip Creek Limestone and Chinaman Creek Limestone faunas studied by Mallett (1970a, 1970b, 1971) range from the late Emsian to early Givetian (equivalent to the Lomandra and Dosey Limestones combined) and include similar generic components to those listed above, as well as *Tienodictyon, Hermatostroma, Stictostroma, Stachyodes* and *Stromatopora*. The uppermost unit is the Stanley Limestone Member of the Mytton Formation, of earliest Frasnian age, and it contains *Actinostroma, Anostylostroma, Stachyodes, Salairella* and *Stromatopora*.

Stromatoporoids from the Devonian reef complexes of the Canning Basin, Western Australia, were documented by Cockbain (1984), who described 25 species, principally from the Sadler Limestone (early–mid Frasnian) and the Pillara Limestone (late Givetian–Frasnian). The genera include *Actinostroma, Anostylostroma, Atelodictyon, Clathrocoilona, Stromatoporella, Dendrostroma, Trupetostroma, Pseudoactinodictyon, Hermatostroma, Stromatopora, Stachyodes* and *Amphipora*. A less diverse assemblage (6 species) occurs in coeval shelf deposits of the Carnarvon Basin (Cockbain 1985). Cockbain (1984, 1989) also recorded small Famennian assemblages comprising species of *Clathrocoilina* and *Stromatopora* from the Canning Basin, and *Pennastroma* and *Platiferostroma* from the Bonaparte Gulf Basin.

EARLY DEVONIAN STROMATOPOROID FAUNAL SUCCESSION AND GLOBAL IMPLICATIONS

Stearn (1979) summarized the major patterns of development of Devonian stromatoporoid faunas as comprising an Early Devonian (Lochkovian–Emsian) history with dominance of holdovers from the Ludlow and Přídolí mixed with a few typically new Devonian genera (Fig. 4), an Eifelian–Frasnian maximum diversification of the fauna (about 45% of the total number of species so far described) and, following the latest Frasnian–Famennian decline, a late Famennian fauna dominated by labechiids. The holdovers from the Silurian include *Labechia,*

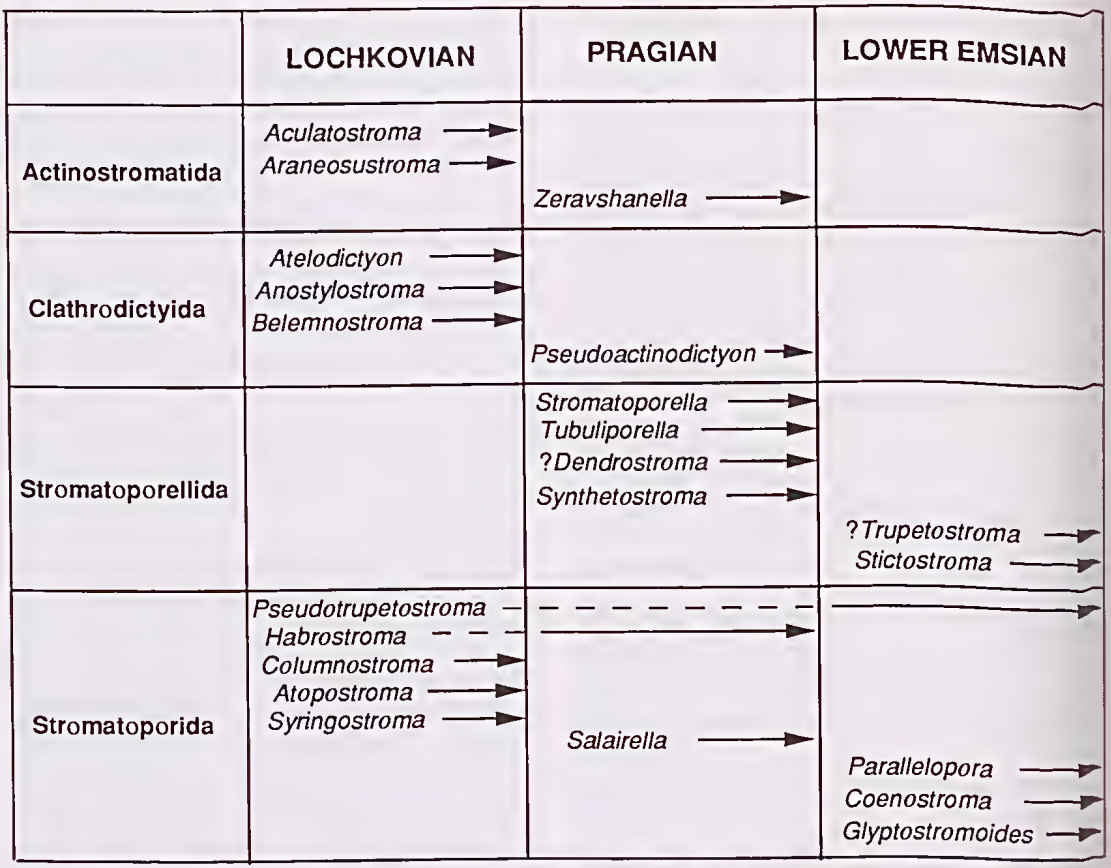


Fig. 4. Diagram showing the probable first appearances of many of the characteristic Devonian genera in Early Devonian time. The genera range upwards (that is, in the direction of the arrows). The Silurian–Devonian boundary is at the base of the Lochkovian (left margin of Lochkovian box), and the Middle Devonian is above the Emsian (off to the right of the diagram). First appearances of *Pseudotrupetostroma* and *Habrostroma* are uncertain: the former, which is only doubtfully known in the Lochkovian and Pragian, was well represented by early Emsian time; and the latter, depending on how the genus is interpreted, originated either in the Přídolí (latest Silurian), Lochkovian or Pragian.

Actinostroma, Plectostroma, Clathrodictyon, Actinodictyon, Parallelostroma, Gerronostroma, Peridiostroma, Clathrocoilina, Stromatopora, Syringostromella and *Amphipora*, and genera making their first appearance early in the Devonian include *Anostylostroma, Hammatostroma, Atelodictyon, Aculatostroma, Hermatostroma* and *Taleastroma* (Stearn 1979, text-fig. 1). Genera viewed by Stearn (1979: 230) as particularly characteristic of the Eifelian to Frasnian are *Parallelopora, Stromatoporella, Trupetostroma, Anostylostroma, Clathrocoilina, Stachyodes* and *Stictostroma*. Many of these, however, originated earlier, for example in the Early Devonian (*Anostylostroma, Parallelopora, Stromatoporella, Stictostroma*) or even in the Silurian (*Clathrocoilina*).

Lochkovian assemblages

The earliest Devonian (Lochkovian) faunas are best characterized by those described by Stock & Holmes (1986) from Virginia and by Stock (1988, 1991) from New York, and are dominated by Silurian holdovers such as *Plexodictyon, Parallelostroma, Densastroma, Intexodictyon, Actinostromella* and *Plectostroma*. In addition, Stock (1991) assigned two of the dominant New York species to the new genus *Habrostroma*, but Stearn (1993) considered these species to be typical representatives of *Parallelostroma*. Stearn prefers to view *Parallelostroma* as giving rise to *Habrostroma* in the middle part of the Early Devonian, rather than near the beginning of the Devonian.

More diverse Lochkovian (Bursychirmana and Kunjakska horizons) assemblages were described by Lesovaya (1970, 1972, 1982, 1986) from the Zeravshan–Gissarskiy Mountains of southern Tien Shan, Central Asia. A few of the genera are Silurian holdovers (*Plectostroma, Simplexodictyon, Amnestotroma, Clathrostroma, Stromatopora, Parallelostroma, Paramphipora*) but many additional genera (*Aculatostroma, Araneosustroma, Atelodictyon, Pseudotrupetostroma*? and *Shirdagopora*) appear for the first time. In the Sarainaya horizon (earliest Devonian, probably Lochkovian) on the eastern slopes of the Urals, Bogoyavlenskaya (1977) recorded a similar association with *Bullatella* (probably *Actinostroma*), *Coenellostroma* (possibly *Atelodictyon*), *Amnestostroma, Syringostromella, Parallelostroma, Columnostroma* and *Stellopora*, representing a mixture of Silurian holdovers and new genera.

Allochthonous limestones in the Stuart Bay Formation (probably of Lochkovian age) on Bathurst Island, Arctic Canada (Stearn 1990), have produced a mixed assemblage with Silurian holdovers and new, Early Devonian elements. These latter include species of *Atopostroma, Anostylostroma* (*A. laxum*, an early representative of the genus), *Habrostroma, Syringostroma* (a genus which arose from *Parallelostroma*) and *Belemnostroma*.

Pragian assemblages

Only a few described Lower Devonian assemblages have confirmed Pragian ages. One such assemblage, from the Kushnovina horizon in the Zeravshan–Gissarskiy Mountains of Central Asia, contains the 'new' genera *Synthetostroma* and *Zeravshanella* (Lesovaya 1982, 1986). The oldest Chinese stromatoporoid assemblage, from the Yujiang Formation of Guangxi, southern China, is of latest Pragian to early Emsian age and is probably more appropriately considered an early Emsian rather than a Pragian association (see below). It includes *Clathrodictyon, Anostylostroma, Atopostroma* and *Parallelostroma* (Yang & Dong 1979).

The most diverse Pragian stromatoporoid assemblages known are those of Lilydale and Tyers Quarry, Victoria. The assemblages contain Silurian holdovers (*Actinostroma, Plectostroma, Clathrodictyon*?, *Schistodictyon*?, *Amnestostroma, Stromatopora* and *Syringostromella*), other genera possibly derived from the 'new' Lochkovian faunas of Asia and North America (*Aculatostroma*?, *Atelodictyon, Pseudotrupetostroma*?, *Columnostroma* and *Habrostroma*), and a number of forms apparently appearing for the first time in the Pragian, at least locally (*Pseudoactinodictyon, Stromatoporella, Tubuliporella, Dendrostroma*? and *Salairella*). *Pseudoactinodictyon* has previously been considered to be restricted to the Middle Devonian (Stearn 1991), and *Salairella* has not been recorded from strata older than Emsian (Stearn 1983). *Dendrostroma* is represented typically as a Middle–Upper Devonian genus (Stearn 1979). First appearances of *Stromatoporella* and *Tubuliporella* include the Victorian species, *Stromatoporella antiqua* Khalfina, 1961 from the Salair region, and species of *Tubuliporella* from the Altai Mountains of south-west Siberia (Khalfina 1968a), all from similar (?Pragian) stratigraphic levels.

Lower Emsian assemblages

A moderately diverse lower Emsian fauna from the Blue Fiord Formation of Arctic Canada has been documented by Stearn (1983). This assemblage has many holdover genera from the Silurian (*Labechia, Gerronostroma, Clathrodictyon, Clathrocoilina, Stromatopora* and *Amphipora*), though actinostromatids are apparently missing. It also exhibits 'new' Devonian genera such as *Atopostroma, Salairella* and *Glyptostromoides*, the latter presumably the earliest record of this genus. Other new genera have been recorded by Stearn & Mehrotra (1970) from the 'Emsian part' of the Ogilvie Formation of the Yukon Territory, Canada, including species of *Anostylostroma, Stictostroma* and ?*Trupetostroma*.

The Victorian (Buchan) lower Emsian assemblages also have Silurian holdover genera (*Actinostroma, Gerronostroma, Petridiostroma, Clathrodictyon, Atelodictyon, Stromatopora, Syringostromella* and *Stellopora*), as well as 'new' genera such as *Stictostroma, Pseudotrupetostroma, Parallelopora, Atopostroma* and *Coenostroma* (also derived from *Parallelostroma*).

Known Chinese lower Emsian assemblages are restricted to the Yujiang Formation (Yang & Dong 1979) of south-central Guangxi (mentioned above) and the Ganxi Formation of northern Sichuan (Wang 1978). Major expansion of the Chinese Devonian stromatoporoids occurred in the late Emsian and is characterized by such diverse assemblages as those in the Guitang Member of the Beiliu Formation of Guangxi (Yang & Dong 1979). Genera present include *Actinostroma, Plectostroma, Cubodic-*

tyon, Gerronostroma, Clathrodictyon, Pseudoactinodictyon, Stromatoporella, Atelodictyon, ?Atopostroma, Stromatopora, Syringostromella, Salairella, Taleastroma and *Habrostroma.*

Summary remarks

Silurian holdover genera declined in importance through the Early Devonian with such forms as *Densastroma, Actinostromella, Intexodictyon* and *Plexodictyon* disappearing by the beginning of the Pragian. In contrast there was a slow and progressive rise in the diversity of new Devonian genera. Approximately equal numbers of new stromatoporoid genera appeared in each successive age of the Early Devonian. While the Labechiida (l) remained little changed, there were significant changes to diversity within the Actinostromatida (ac), Clathrodictyida (c), Stromatoporellida (se) and Stromatoporida (so). In the Lochkovian (Fig. 4), based especially on the records in Central Asia (Uzbekistan) and Arctic Canada, the genera *Aculatostroma* (ac), *Araneosustroma* (ac), *Atelodictyon* (c), *Anostylostroma* (c), *Belemnostroma* (c), possibly *Pseudotrupetostroma* (so), possibly *Habrostroma* (so), *Atopostroma* (so), *Columnostroma* (so) and *Syringostroma* (so) appeared. Pragian first appearances, based particularly on the Victorian record, comprise the genera *Pseudoactinodictyon* (c), *Stromatoporella* (se), *Tubuliporella* (se), possible *Dendrostroma* (se), *Habrostroma* (so), *Salairella* (so) and, based on Middle Asian and Chinese occurrences, *Zeravshanella* (ac) and *Synthetostroma* (se). Early Emsian first appearances, judging from the Victorian and Canadian Arctic records, include possibly *Truptetostroma* (se), *Stictostroma* (se), *Pseudotrupetostroma* (so), *Parallelopora* (so), *Coenostroma* (so) and *Glyptostromoides* (so).

Consequently, by the end of the early Emsian (prior to the time of the *serotinus* conodont Biozone) many of the characteristic Middle Devonian genera, such as *Anostylostroma, Stromatoporella, Stictostroma, Parallelopora* and *Syringostroma*, had appeared. Their subsequent diversification, associated with the major Middle Devonian period of reef development, mainly involved expansion of stocks at the species level.

The patterns of development of Lower Devonian stromatoporoid faunas are now well-documented based on assemblages in Central Asia, China and eastern Australia, and suggest a gradual appearance of new Devonian stocks through Lochkovian, Pragian and Emsian time (Fig. 4), rather than a sudden evolutionary burst of new innovations immediately prior to the major period of active reef growth in the Middle Devonian.

SYSTEMATIC DESCRIPTIONS

All type and figured specimens (with accompanying separately numbered thin sections) are housed in the palaeontological collections of the Museum of Victoria, Melbourne (NMV P). The museum collections include some specimens that have been transferred from the Geology Department of Melbourne University; for these specimens the original MUGD registration numbers are cited herein, as well as the Museum registration numbers. Note that each type specimen normally has more than one designated Museum registration number—one for the hand specimen and separate numbers for each vertical and tangential thin section.

Ripper also deposited collections of Victorian Devonian stromatoporoids in the Natural History Museum, London, and in the Sedgwick Museum, Cambridge, England. These have been examined by Stearn and by Webby (the Natural History Museum collection only). Another small collection of offcuts is held by the Queensland Museum, Brisbane, but has not been studied by us.

Matthews (1973) recommended use of open nomenclature for certain specimens whose identity could not be exactly determined. This practice has been followed herein, including the use of a question mark where generic or specific assignments are not certain. Other attributions include *aff.* for specimens exhibiting affinities close to but not identical with the established species, and *cf.* for specimens showing comparison with the established species.

For localities of specimens, see the following 1:100 000 topographic map sheets: (1) the Lilydale area, see map sheet 7922 Ringwood for Mitchell's (or Cave Hill) Quarry (grid ref. 813533 to 817536); (2) the Buchan area, see map sheet 8522 Orbost for Martin Cameron's Quarry (grid ref. 002431) and Heath's Quarry (grid ref. 034422), and map sheet 8523 Murrindal for Rocky Camp (Commonwealth) Quarry (grid ref. 060528) and the roadside locality (L4) south of Murrindal School (grid ref. 063576); (3) the Tyers–Coopers Creek areas, see map sheet 8121 Moe for Tyers Quarry (grid ref. 495811) and map sheet 8122 Matlock for Evans Quarry, near Coopers Creek (grid ref. 492958); (4) the Wara-

tah Bay area, see map sheet 8020 Wonthaggi for the old lime kilns site at Walkerville South (grid ref. 129983) and the '*Amphipora*' horizon at the mouth of Bluff Creek, near the Bluff, Walkerville (grid ref. 129985); and (5) the Loyola area, see map sheet 8123 Mansfield for the Lime Kiln Quarry (grid ref. 909129) and Griffith's Quarry (grid ref. 904133) south of Mansfield.

Class Stromatoporoidea Nicholson & Murie, 1879

Order Actinostromatida Bogoyavlenskaya, 1969

Family Actinostromatidae Nicholson, 1886b [*nom. correct.* Steehow, 1922, *ex* Actinostromidae Nicholson, 1886b]

Genus Actinostroma Nicholson, 1886b

Type species. A. clathratum Nicholson, 1886a.

Actinostroma compactum Ripper, 1933

Figs 5A–F, 7A–C

Actinostroma compactum Ripper 1933: 153, fig. 5A–B.—Ripper 1937e: 15, pl. 2, figs 7–8.—Ripper 1938: 236.—Teichert & Talent 1958: 16, 20.—Flügel & Flügel-Kahler 1968: 81.

cf. *Actinostroma (Actinostroma)* cf. *compactum*.—Flügel 1958a: 55.—Flügel 1958b: 180.

Actinostroma (Actinostroma) compactum.—Flügel 1959: 134.

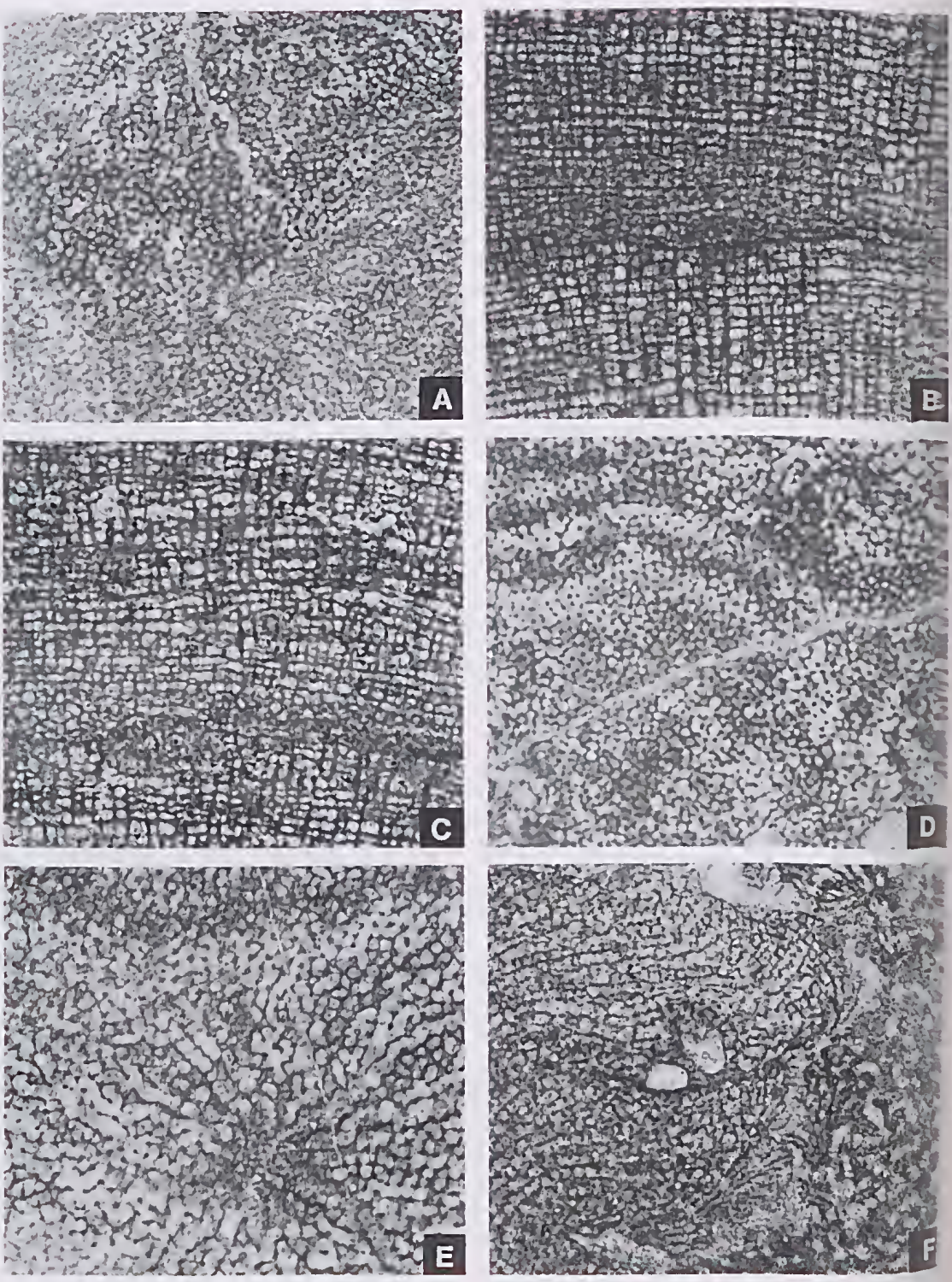
Material. Holotype (NMV P141959–60, *ex* NMV P13742) and one paratype (NMV P141885–86) as designated by Ripper (1933). Ripper's (1933) other two paratypes (NMV P141989, *ex* NMV P13743; and NMV P142002, *ex* NMV P13744) should be excluded from the species, as this material represents poorly preserved specimens of *Atopostroma*. The holotype and paratype are from the Lilydale Limestone at Mitchell's (Cave Hill) Quarry, Lilydale. Ripper (1937e) also figured NMV P141806–07 (*ex* MUGD 1617) from Heath's Quarry, Buchan Caves Limestone, near Buchan. Ten other specimens come from the Buchan Caves Limestone at Heath's Quarry (NMV P136228–29, P136230–32, P136233–34, P141761–62, P141791–92, P141802–03, P141789–90, P141794–95, P141804–05), and one specimen from Martin Cameron's Quarry (NMV P136235–36), also near Buchan. In addition, the species is recorded from the Murrindal Limestone at Rocky Camp Quarry near Buchan: three specimens (NMV P136237–38, P136239–40, and P141694).

Description. External details of this species remain uncertain, though a few recently collected specimens show a laminar to low domical external form. Latilaminae conspicuous, and usually 2 to 8 mm thick, but in extremes may be as little as 1.0 mm to more than 15 mm thick. Many specimens exhibit scattered, large, rounded spar-filled cavities up to 1 mm in height and 1.5 mm in width, possibly repesenting a symbiotic organism such as *Topsentopsis* de Laubenfels, 1955. In one thin section (NMV P141802) an irregular basal phase has formed where it grew in competition for available space with a species of *Stromatopora*. A few specimens have broadly undulating laminae, 9 to 14 mm from crest to crest; and these may or may not show associated astrorhizal clusters.

In vertical sections pillars are moderately continuous, traceable for up to 5 mm vertically; confined to latilaminae and interrupted by thickened and relatively disordered phases at the bases of successive latilaminae; this thickened, irregular basal zone may be up to 1 mm thick; pillars from 9 to 12 in 2 mm, and individually 0.04 to 0.10 (typically 0.07) mm in diameter. Laminae usually relatively evenly spaced and continuous, though at a few levels more undulating and laterally discontinuous; individually they may be traced for up to 14 mm laterally; spaced from 10 to 14 in 2 mm vertically, and with rod-like colliculi of each lamina varying from 0.03 to 0.07 (on average 0.05) mm in diameter.

In tangential sections pillars cut as rounded dots, from 0.04 to 0.10 (on average 0.07) mm across, locally with diagenetically replaced centres, and spaced from 0.1 to 0.2 mm apart (with usually 25 to 30 counted in 1 mm^2); hexactinellid networks develop from three to five finer colliculi intersecting each pillar. Astrorhizal canals are most conspicuous in tangential sections, forming parts of an irregularly radiating and branching, stellate structure; these clusters may be large, up to 9 mm across, and may be spaced from between 4 and 12 mm apart through the skeleton; and they only rarely appear to be superposed (NMV P141791); in the periaxial parts of the cluster, individual branching, astrorhizal canals up to 0.25 mm wide (usually 0.15–0.25 mm) occur, but towards the axis of the stellate cluster (within 0.5 mm of the axis), a finer meshwork of vertical pillar-like and horizontal rod-like processes may be seen (NMV P141762); the astrorhizal canals are wall-less (only bounded in places by an alignment of adjacent colliculi). Microstructure in better preserved material is compact.

Remarks. Preservation of the material from the Lilydale and Buchan localities is somewhat variable; the best preserved specimens come from Heath's Quarry in the Buchan Caves Limestone,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and from the Roeky Camp Quarry in the Murrindal Limestone. The skeletal material of some speeimens from Lilydale and from the Buehan Caves Limestone is markedly thiekened. In eontrast, most of the forms from the Roeky Camp loeality have pillars and eollieuli with a similar spaeing to the other stratigraphieally lower, Buehan Caves Limestone representatives, but the elements are somewhat more delieate (?less thiekened). However, no sharp line ean be drawn between the speeimens of these stratigraphieally distinct levels. A distinetion may also be suggested between the sheet-like, narrowly latilaminate, and the mammillate (often with astrorhizal elusters), more widely latilaminate forms in the assemblages, but again there are gradations between these two groups at both the Lilydale and the Buchan loealities. Consequently a broad eoneeption of the speeies is maintained.

Ripper (1933, 1937e) drew attention to the elose relationship between this speeies and the type speeies, *Actinostroma clathratum*, and this relationship was eonfirmed by Flügel (1959). The main differenees were given by Ripper as 'the eloser erowding' of pillars and laminae of the Vietorian speeies, and the 'fairly regular doming' of laminae to form mamelons. Flügel (1959) added that *A. compactum* oeeupied an intermediate position morphologieally between the eoarser *A. clathratum* and the finer *A. stellulatum* Nieholson, 1886a. Material from the alloehthonous Early Devonian (Emsian) Jesse Limestone of the Limekilns area, eentral New South Wales, inelude representatives of all three morphologies (see Webby & Zhen 1993, and Fig. 6 herein). Speeimens of the Pragian *A. compactum* from the type loeality at Lilydale are shown in Fig. 6 to oeeupy an intermediate position between the slightly younger (Emsian) and more variable material (grouped in three speeies) from the Jesse Limestone. It should be noted that *A. clathratum* and *A. stellulatum* are eharaeteristieally Middle and early Late Devonian speeies in Europe and Asia (Flügel 1959), but that the oeeurrenees in New South Wales are of Emsian age.

Ripper (1933) assigned two Lilydale speei-

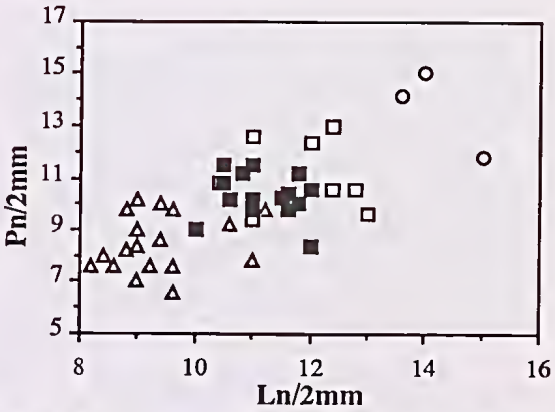


Fig. 6. Scatter diagram of number of pillars and number of laminae in 2 mm to show the range of variability in the species of *Actinostroma* from the Jesse Limestone of the Limekilns area, central New South Wales (Webby & Zhen 1993), and the Lilydale Limestone at Lilydale, central Victoria. Key to symbols: open triangles, *A. clathratum* (Limekilns); solid squares, *A. compactum* including type specimens (Lilydale); open squares, *A. compactum* (Limekilns); and open circles, *A.* aff. *stellulatum* (Limekilns).

mens to *Actinostroma verrucosum* (Goldfuss, 1826). Only the figured speeimen is presently available for study in the eolleetions of the Museum of Vietoria (NMV P141889–90, *ex* MUGD 1446); the other is missing. This is a strongly mammillate form with well developed vertieal astrorhizal eanals eentred within the mamelon eolumns. The mamelons are spaeed from 5 to 8 mm apart, and the astrorhizal eanals are wall-less struetures up to 0.5 mm in diameter. Pillars are of similar dimensions and arrangement to those of *A. compactum*, spaeed from 8 to 10 in 2 mm. Laminae are eontinuous and formed of regularly spaeed eollieuli in parts of the skeleton, but also show alternations between these open, regularly spaeed laminae and elosely-spaeed, clustered, slightly imbrieate rows of small globose elements suggestive of dissepiments; these alternating patterns suggest fluetuating rates of growth. Clearly more material must be found to eonfirm the presenee of *A. verrucosum* in Vietoria.

Fig. 5. Actinostroma compactum Ripper, 1933, × 10; A, NMV P141807 (*ex* MUGD 1617), tangential section; B, NMV P141806 (*ex* MUGD 1617), vertical section; C, paratype NMV P141885, vertical section; D, holotype NMV P141959 (*ex* NMV P13742), tangential section; E, NMV P141762, tangential section; F, NMV P141803, vertical section showing intergrowth with *Stromatopora* aff. *polaris* (Stearn, 1983) and development of basal phase in the contact zone between them. A, B, E, F from Buchan Caves Limestone at Heath's Quarry; C, D from Lilydale Limestone at Cave Hill Quarry.

The collections include one additional specimen, not referrable to *A. compactum*, from the Waratah Limestone of the old lime kilns site at Walkerville South (NMV P136400–41, *ex* NMV P136213). The specimen, here informally assigned to *Actinostroma* sp., is perhaps allied to *A. stellulatum* but differs from that species in having relatively thicker pillars, 0.1 mm in diameter (Fig. 7D). These pillars appear to have hollow centres, possibly as a result of diagenetic alteration. The laminae are continuous, closely and evenly spaced, from 15 to 20 in 2 mm.

Genus Plectostroma Nestor, 1964

Type species. Actinostroma intertextum Nicholson, 1886a.

Remarks. Flügel (1959) included three Devonian species (*A. salairicum* Yavorsky, 1930, *A. altum* Ripper, 1933 and *A. ligeriense* Le Maître, 1934) in the species group of *Actinostroma intertextum*, now attributed to *Plectostroma*. Nestor (1964) and Mori (1969) noted that the radial processes (colliculi) of *Plectostroma* are developed at different levels, not consistently at the same levels as in the regular net-like laminae of *Actinostroma*.

Plectostroma altum (Ripper, 1933)

Figs 7E–F, 8A–D

Actinostroma altum Ripper 1933: 156, figs 2, 5E–F.—Philip 1960: 151.—Flügel & Flügel-Kahler 1968: 22.

Actinostroma (Actinostroma) altum.—Flügel 1959: 125.

Material. Holotype (NMV P141894–95, P141951–53; *ex* NMV P13745) and topotype (NMV P141903–05, P141941–43; *ex* NMV P13761) from the Lilydale Limestone, Mitchell's (Cave Hill) Quarry, Lilydale. Fig. 2 of Ripper (1933) is drawn from holotype, NMV P141895; fig. 5E is from NMV P141952; and fig. 5F is from NMV P141951. An additional, well preserved specimen (NMV P136241–42, *ex* NMV P136149) comes from the Coopers Creek Limestone at Tyers Quarry.

Description. Skeleton apparently laminar to domical, exhibiting latilaminae from 2 to 8 mm thick. In vertical sections composed of somewhat disordered meshwork of vertical pillars and laminae with irregularly offset, rod-like, colliculi. Pillars are thin, usually continuous through several laminae, observed to extend for up to 2 (in extremes to 4) mm vertically; may be sinuous (possibly in part associated with branching) and commonly scattered throughout the skeleton; 7–10 pillars in 2 mm; individual width from 0.045 to 0.1 mm.

Laminae somewhat undulating, thin but may be variably thickened, and may form a part of laterally continous or more irregularly discontinous tissue; rod-like colliculi of the laminae may intersect pillars at the same level, or at different levels; in some places these latter structures appear as isolated or aligned rows of rounded dots within gallery spaces in vertical sections; laminae spaced from 8 to 10 in 2 mm; individual laminae from 0.02 to 0.08 mm thick. Scattered, variable-sized, upwardly domed-shaped dissepiments may occur through the skeleton, and also much smaller, vertical and horizontal, tube-like astrorhizae, from 0.2 to 0.3 mm wide. Large and small (?worm) tubes may also be associated, the former being up to 1.8 mm across and 1.2 mm in height, and the latter from 0.2 to 0.3 mm across. Thickened zones of horizontal and vertical structural elements define the boundaries between latilaminae. Microstructure is apparently compact.

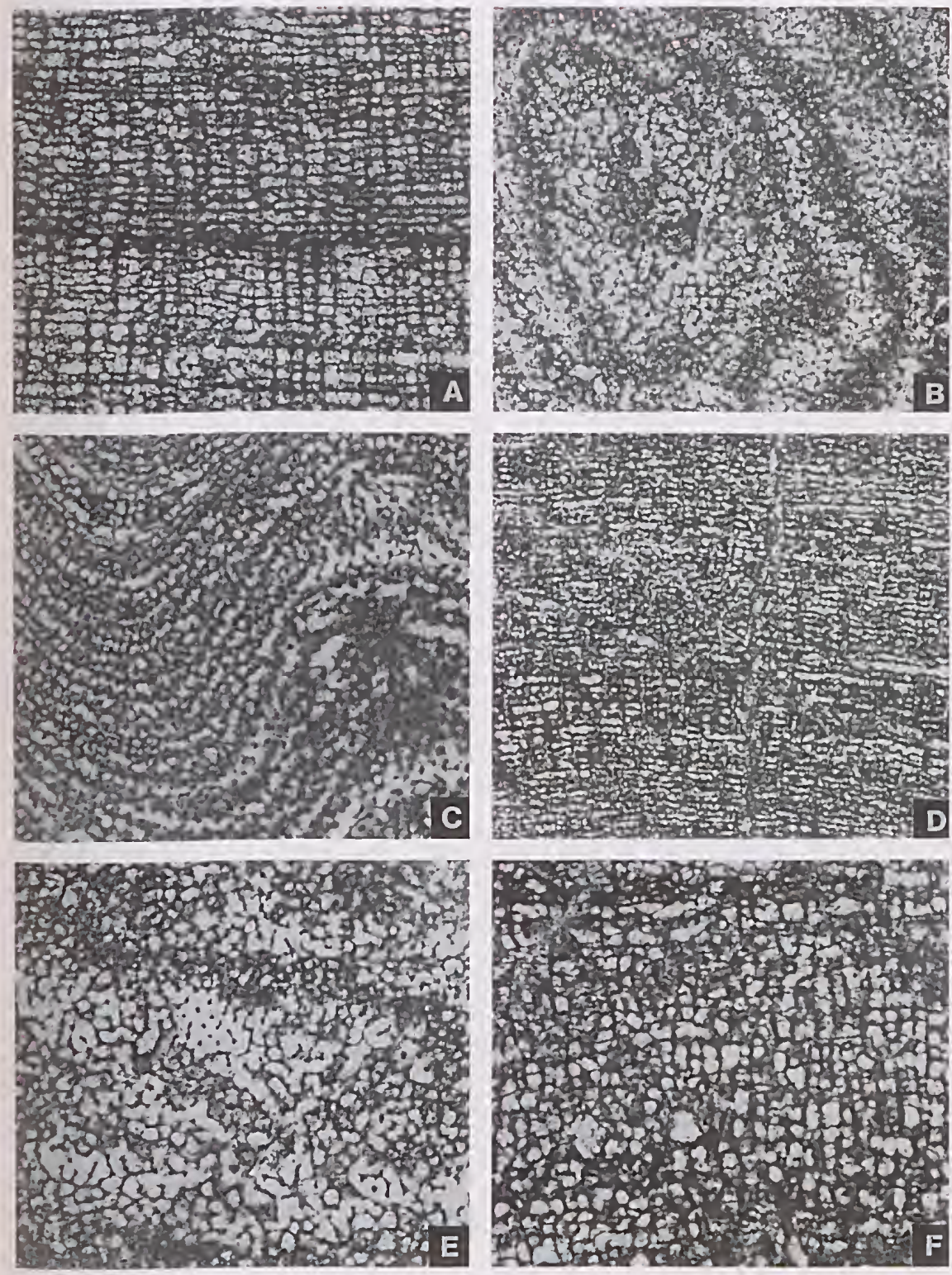
In tangential sections the pillars appear as rounded dots and tend to be slightly thicker than connecting colliculi; well-developed hexactinellid network is only shown in scattered areas of the skeleton; pillars are from 0.05 to 0.1 mm in diameter, and spaced from 0.1 to 0.2 mm apart; about 16 to 30 pillars spaced within 1 mm^2. Astrorhizae incompletely radiating.

Remarks. Ripper (1933) emphasized the close relationship of this Victorian species to *P. intertextum*. However, she seems to have mistakenly interpreted all the upwardly curved lateral structures of *P. altum* as laminae, though some of these, from tangential-oblique sections, can clearly be seen to be curved dissepimental plates. Furthermore, though she doubted that astrorhi-

Fig. 7. A–C, *Actinostroma compactum* Ripper, 1933, × 10; A, NMV P136237 (*ex* NMV P136147), vertical section; B, NMV P136238 (*ex* NMV P136147), tangential section; A, B, Murrindal Limestone, Rocky Camp Quarry; C, NMV P141791, vertical–oblique section, Buchan Caves Limestone, Heath's Quarry. D, *Actinostroma* sp., NMV P136400 (*ex* NMV P136213), vertical section, × 10, Waratah Limestone, limekilns site, Walkerville South. E, F, *Plectostroma altum* (Ripper, 1933), × 10, Lilydale Limestone, Mitchell's (Cave Hill) Quarry; E, holotype NMV P141952 (*ex* NMV P13745), tangential section; F, holotype NMV P141951 (*ex* NMV P13745), vertical section.

CORRIGENDUM

The accompanying sheet replaces pages 127 and 128 of Proceedings of The Royal Society of Victoria, Vol. 105, No. 2.
As originally issued, page 128 of that number contained a printing error.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zae were present in *P. altum*, they are plainly visible as incompletely developed, radiating astrorhizal canals in tangential sections of the holotype. *P. intertextum* has closer-spaced laminae (7–12 per mm) and pillars (5–9 per mm), and the astrorhizae are finer (0.09–0.19 mm), according to C. W. Stock (pers. comm.).

From the two other known Devonian species of *Plectostroma*, *P. salairicum* (Yavorsky, 1930) from the Kuznetsk Basin of Siberia, and *P. ligeriense* (Le Maître, 1934) from the Ancenies Basin of France, *P. altum* differs in exhibiting better defined latilaminae, as well as differing from the former in having slightly more widely spaced laminae and from the latter b

FAGERSTROM J. A., 1982. Stromatoporoids of the ideyakh *Institut Royal des* LESOVAYA, A. I., 1982. Ranne- i srednedevnskie strohe Royal Society of Victoria 106.

renclature and Mehotra, P. N., 1970. Lower and 2.

Type species. Syringostroma verrucosum Khalfina, 1961.

Aculatostroma? sp.

Fig. 8E–F

Syringostroma densum.—Ripper 1937a: 182, pl. 8, figs 3–5.—Ripper 1938: 236.

Material. One specimen (NMV P141877–80, *ex* MUGD 1620) from the Lilydale Limestone at Mitchell's (Cave Hill) Quarry, Lilydale. Another specimen (NMV P136398–99, *ex* NMV P136227) from the Waratah Limestone at the old lime kilns site at Walkerville South is doubtfully assigned.

Comparative description. Ripper (1937a) noted that this specimen was nearly identical with the type species of *Syringostroma, S. densum* Nicholson, 1875 from the Columbus Limestone of Ohio. However it does not show the distinctive larger set of pillars, now known as "megapillars' (Fagerstrom 1982), which in part characterizes the genus. The clinoreticulate megapillars, the diffuse nature of the skeletal material and the prominent microlaminae are taken as typical features of *Syringostroma.*

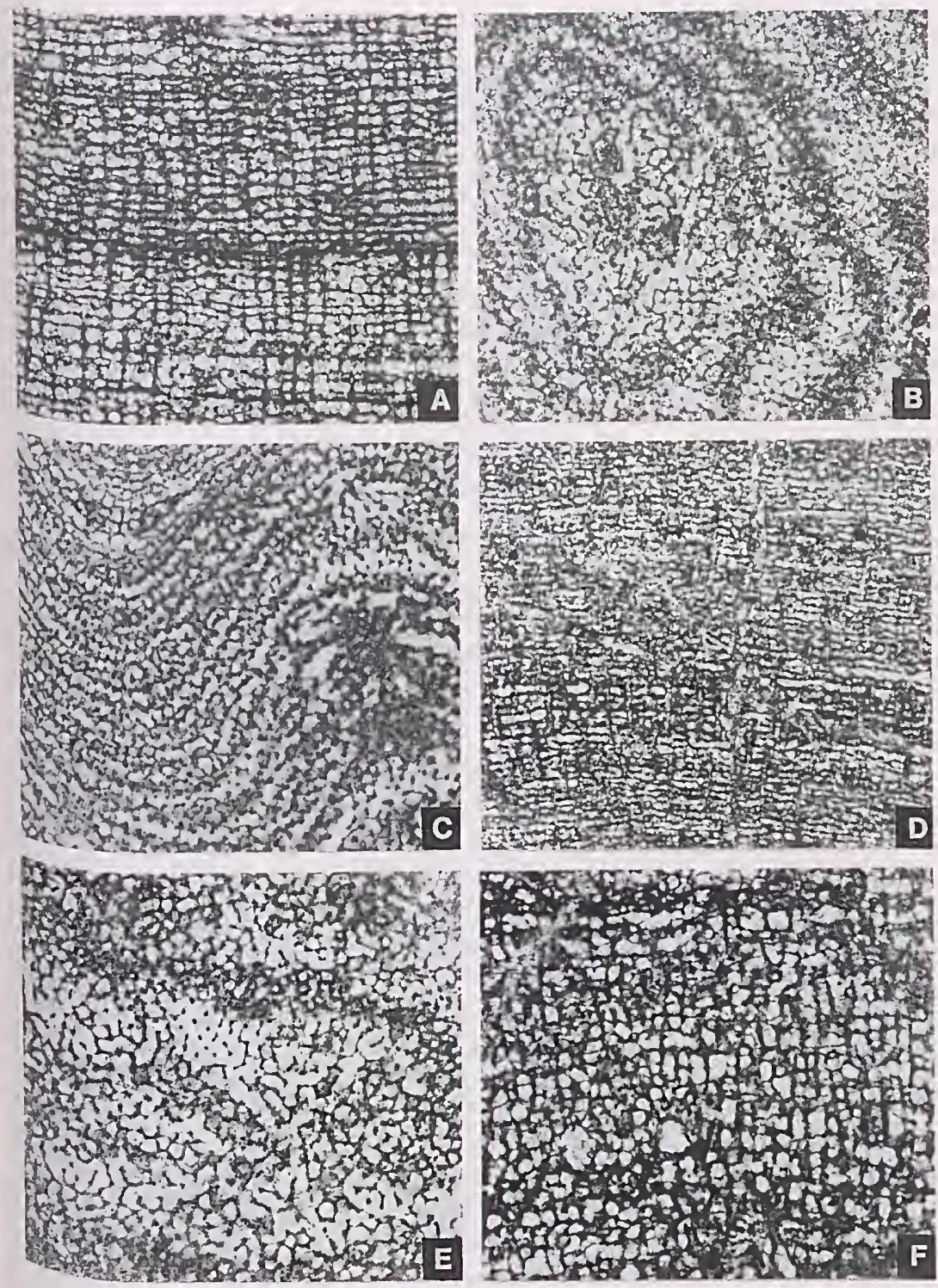
Ripper (1937a) provided a good description of the Lilydale specimen, featuring its well defined latilaminae from 2 to 5 mm thick (commonly differentiated with a basal thickened zone from 0.7 to 0.9 mm thick), and its irregularly reticulated meshwork comprising slender pillars, up to 0.1 mm in diameter and commonly short, in places superposed but seldom through more than a few interlaminar spaces. She recorded colliculi intersecting the pillars at irregular intervals, and also, at other levels, colliculi coalescing to form laminae, commonly spaced about 5 to 6 in 2 mm and typically at levels where the pillars are interrupted. Astrorhizae are commonly associated with the thickened basal parts of the latilaminae, although a few that are parallel to growth and oblique to vertical canals may also occur more randomly through the rest of the skeleton; they are mainly up to 0.3 mm in diameter.

In tangential section through an interlaminar space, the pillars are round to vermiform with few being interconnected by colliculi, but where the laminae are intersected a fine-textured, closed mesh of comparatively dense, thickened structural elements (pillars and colliculi) is shown; the 'pores' in the laminae are typically rounded and about 0.1 mm in diameter. Astrorhizae are large with six or more radiating and branching canals, up to 0.4 mm across, extending from centres. Under magnification the pillars in tangential section show a very fine speckled, apparently cellular skeletal material; the cellules are 0.01 to close to 0.02 mm across.

The Lilydale specimen shows laminae as a network of colliculi arising from upwardly dividing pillars but is not closely similar to other species of *Aculatostroma* (Stearn 1991). It has some resemblance to *A. ordinatum* (Stearn, 1961) from the Cairn Formation (Middle or Upper Devonian) of Alberta but differs in exhibiting a clustering of astrorhizae near the bottoms rather than the tops of latilaminae. It is therefore left in open nomenclature.

The Waratah specimen has a less densely, thickened meshwork in tangential section and is therefore also doubtfully assigned to *Aculatostroma.*

Fig. 8. A–D, *Plectostroma altum* (Ripper, 1933), × 10; A, topotype NMV P141903 (*ex* NMV P13761), vertical section; B, holotype NMV P141951 (*ex* NMV P13745), vertical section; C, NMV P136241 (*ex* NMV P136149), vertical section; D, NMV P136242 (*ex* NMV P136149), tangential section. E, F, *Aculatostroma*? sp., × 10; E, NMV P141878 (*ex* MUGD 1620), vertical section; F, NMV P141877 (*ex* MUGD 1620), tangential section. A, B, E, F, Lilydale Limestone at Mitchell's (Cave Hill) Quarry; C, D, Coopers Creek Limestone, Tyers Quarry.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zae were present in *P. altum*, they are plainly visible as incompletely developed, radiating astrorhizal canals in tangential sections of the holotype. *P. intertextum* has closer-spaced laminae (7–12 per mm) and pillars (5–9 per mm), and the astrorhizae are finer (0.09–0.19 mm), according to C. W. Stock (pers. comm.).

From the two other known Devonian species of *Plectostroma*, *P. salairicum* (Yavorsky, 1930) from the Kuznetsk Basin of Siberia, and *P. ligeriense* (Le Maître, 1934) from the Ancenies Basin of France, *P. altum* differs in exhibiting better defined latilaminae, as well as differing from the former in having slightly more widely spaced laminae and from the latter bFAGERSTROM J. A., 1982. Stromatoporoids of the ideyakh *Institut Royal des* LESOVAYA, A. I., 1982. Ranne- i srednedevnskie strohe Royal Society of Victoria 106.

renclature and Mehotra, P. N., 1970. Lower and 2.

Type species. *Syringostroma verrucosum* Khalfina, 1961.

Aculatostroma? sp.

Fig. 8E–F

Syringostroma densum.—Ripper 1937a: 182, pl. 8, figs 3–5.—Ripper 1938: 236.

Material. One specimen (NMV P141877–80, *ex* MUGD 1620) from the Lilydale Limestone at Mitchell's (Cave Hill) Quarry, Lilydale. Another specimen (NMV P136398–99, *ex* NMV P136227) from the Waratah Limestone at the old lime kilns site at Walkerville South is doubtfully assigned.

Comparative description. Ripper (1937a) noted that this specimen was nearly identical with the type species of *Syringostroma*, *S. densum* Nicholson, 1875 from the Columbus Limestone of Ohio. However it does not show the distinctive larger set of pillars, now known as "megapillars' (Fagerstrom 1982), which in part characterizes the genus. The clinoreticulate megapillars, the diffuse nature of the skeletal material and the prominent microlaminae are taken as typical features of *Syringostroma*.

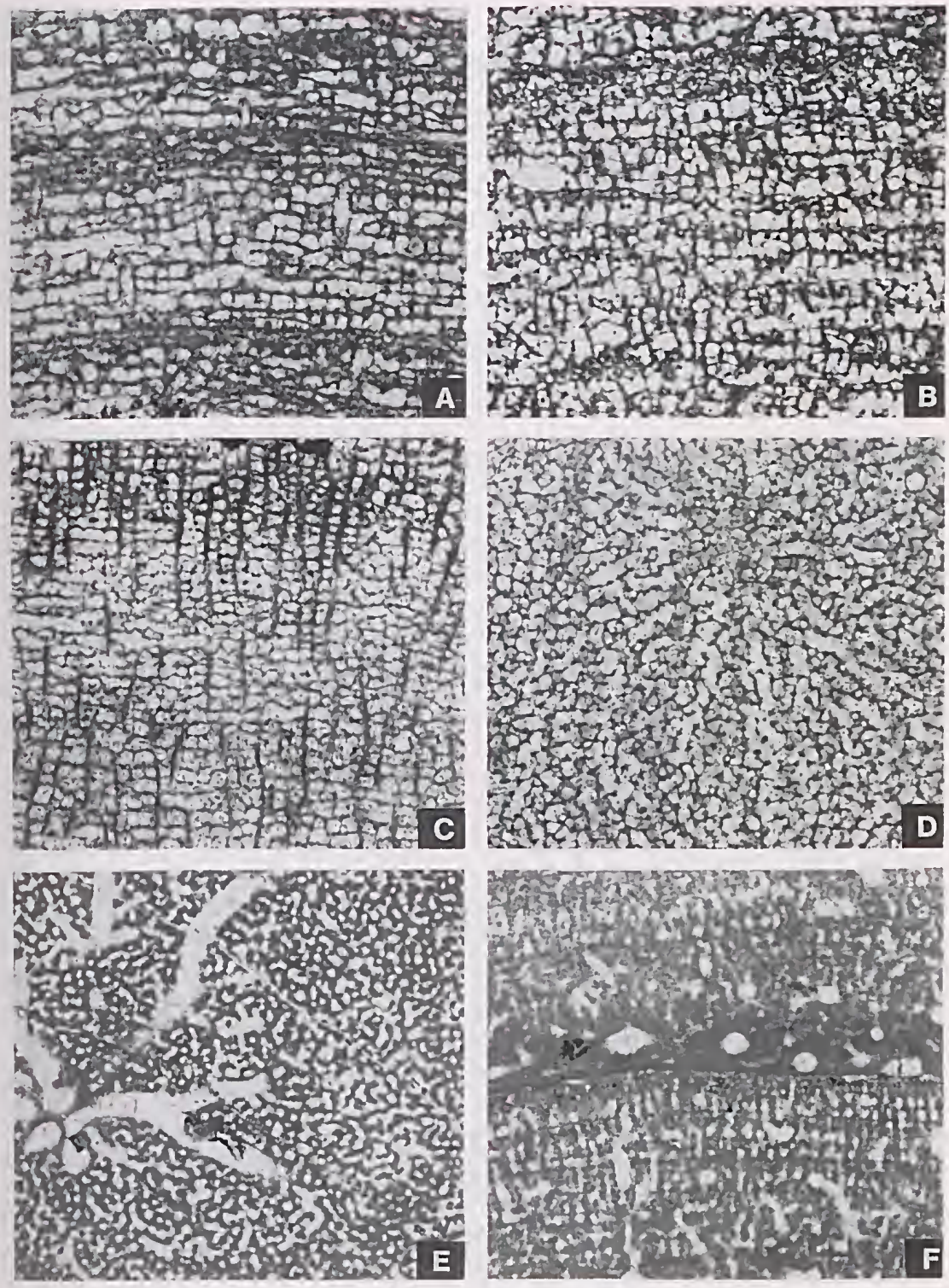
Ripper (1937a) provided a good description of the Lilydale specimen, featuring its well defined latilaminae from 2 to 5 mm thick (commonly differentiated with a basal thickened zone from 0.7 to 0.9 mm thick), and its irregularly reticulated meshwork comprising slender pillars, up to 0.1 mm in diameter and commonly short, in places superposed but seldom through more than a few interlaminar spaces. She recorded colliculi intersecting the pillars at irregular intervals, and also, at other levels, colliculi coalescing to form laminae, commonly spaced about 5 to 6 in 2 mm and typically at levels where the pillars are interrupted. Astrorhizae are commonly associated with the thickened basal parts of the latilaminae, although a few that are parallel to growth and oblique to vertical canals may also occur more randomly through the rest of the skeleton; they are mainly up to 0.3 mm in diameter.

In tangential section through an interlaminar space, the pillars are round to vermiform with few being interconnected by colliculi, but where the laminae are intersected a fine-textured, closed mesh of comparatively dense, thickened structural elements (pillars and colliculi) is shown; the 'pores' in the laminae are typically rounded and about 0.1 mm in diameter. Astrorhizae are large with six or more radiating and branching canals, up to 0.4 mm across, extending from centres. Under magnification the pillars in tangential section show a very fine speckled, apparently cellular skeletal material; the cellules are 0.01 to close to 0.02 mm across.

The Lilydale specimen shows laminae as a network of colliculi arising from upwardly dividing pillars but is not closely similar to other species of *Aculatostroma* (Stearn 1991). It has some resemblance to *A. ordinatum* (Stearn, 1961) from the Cairn Formation (Middle or Upper Devonian) of Alberta but differs in exhibiting a clustering of astrorhizae near the bottoms rather than the tops of latilaminae. It is therefore left in open nomenclature.

The Waratah specimen has a less densely, thickened meshwork in tangential section and is therefore also doubtfully assigned to *Aculatostroma*.

Fig. 8. A–D, *Plectostroma altum* (Ripper, 1933), × 10; A, topotype NMV P141903 (*ex* NMV P13761), vertical section; B, holotype NMV P141951 (*ex* NMV P13745), vertical section; C, NMV P136241 (*ex* NMV P136149), vertical section; D, NMV P136242 (*ex* NMV P136149), tangential section. E, F, *Aculatostroma*? sp., × 10; E, NMV P141878 (*ex* MUGD 1620), vertical section; F, NMV P141877 (*ex* MUGD 1620), tangential section. A, B, E, F, Lilydale Limestone at Mitchell's (Cave Hill) Quarry; C, D, Coopers Creek Limestone, Tyers Quarry.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Order CLATHRODICTYIDA Bogoyavlenskaya, 1969

Family CLATHRODICTYIDAE Kühn, 1927

Genus Gerronostroma Yavorsky, 1931

Type species. G. elegans Yavorsky, 1931.

Gerronostroma buchanense (Flügel, 1959)

Fig. 9A–D

non *Actinostroma contortum* Gorsky 1935: 10, 88, pl. 1, figs 1–4.

Actinostroma contortum.—Ripper 1937c: 14, pl. 2, figs 3–6.—Ripper 1938: 236.—Galloway & St Jean 1957: 237.—Teichert & Talent 1958: 16, 20.—Flügel & Flügel-Kahler 1968: 101.

Actinostroma (Actinostroma) buchanense Flügel 1959: 183, pl. 7, fig. 4.

Actinostroma buchanense.—Flügel & Flügel-Kahler 1968: 52.

Material. Holotype (NMV P141758, *ex* MUGD 1611) is from the Buchan Caves Limestone at Heath's Quarry, near Buchan. One other specimen (NMV P141749–50) from the type locality is also assigned to the species, and several specimens from the Murrindal Limestone at Rocky Camp Quarry near Buchan, including Ripper's (1937c) figured specimen (NMV P141690–91, *ex* MUGD 1604), and other specimens (NMV P136243–44, P136245–46, P136247–48, P136249–50, P136251–52, P13653–54, P136255–56, P141692–93, P141700–01, P141707–08, P141713–14, P141716–18, P141729 and P141733).

Description. Skeleton apparently low domical to massive with the growth surface commonly rising into low domal mamelons, spaced from 3.5 to 8 mm between crests, and of moderate relief, from 1.5 to 4 mm in height. Growth interruption surfaces occur in a few places, as well as phases of more closely-spaced laminae, this latter perhaps suggesting a slower growth between successive latilaminae; these phases are spaced from 2 to 3 mm apart. Astrorhizae are well developed within mamelon columns; the complexly partitioned vertical canals are from 0.35 to 1.5 mm in diameter.

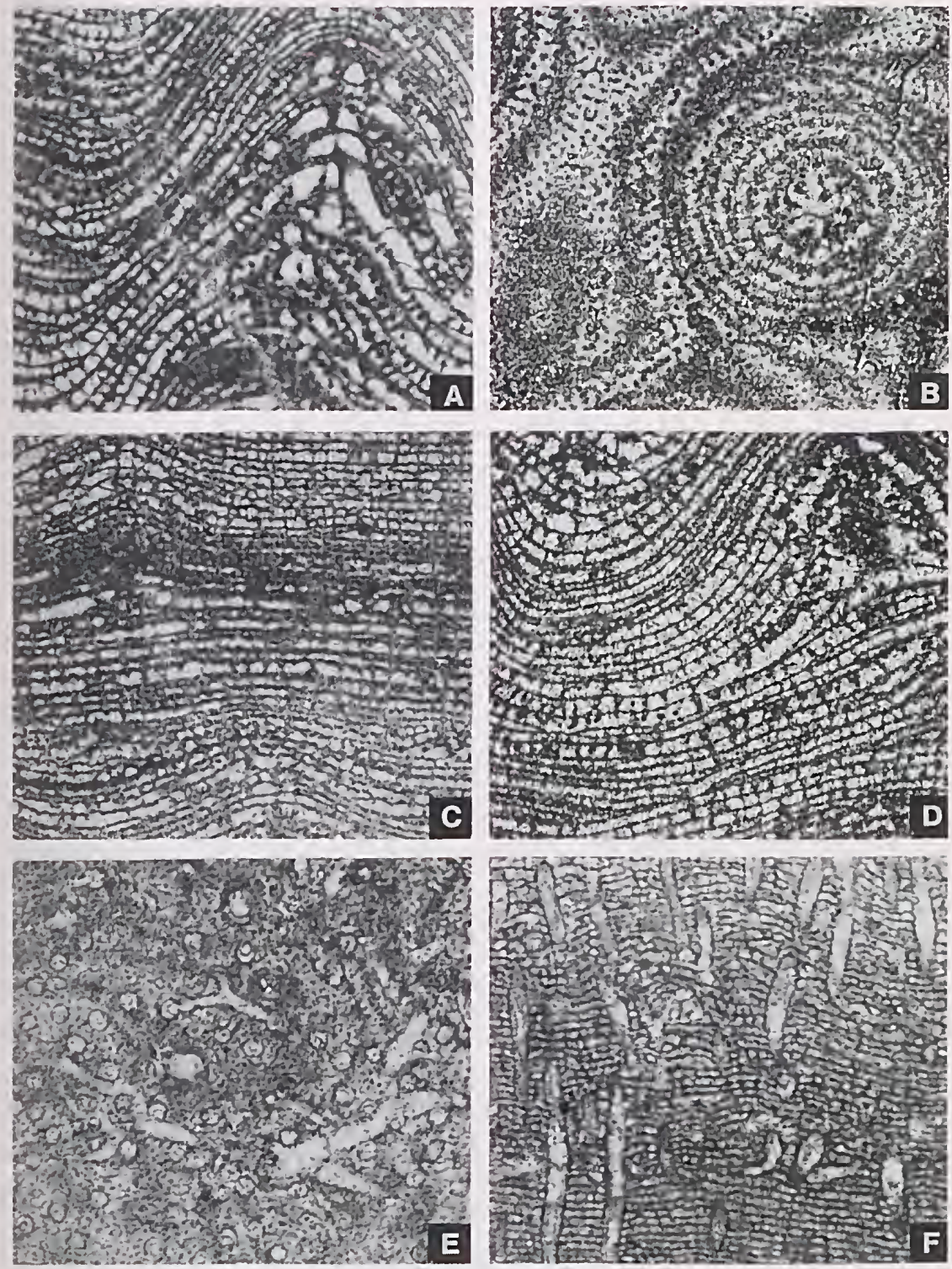
In vertical sections, laminae are thin (0.025–0.05 mm), continuous, broadly flexuous, and somewhat irregularly spaced; apparently composed of a single layer of compact skeletal material, and spaced from 7 to 15 (usually 10–12) in 2 mm. In places, especially towards upper flanks and crest of mamelon columns, laminae are closely spaced and intermittently come in contact with neighbours; locally, particularly in troughs between mamelon columns, such laminae are difficult to distinguish from broadly flexuous, long, low dissepiments; a few other distinctive, vesicular-type dissepiments also occur in parts of the skeleton, especially in areas where laminae are widely spaced.

Pillars are distributed randomly, in places long and regularly superposed through at least 10 laminae, and in other places confined to one or two interlaminar spaces; from 0.05 to 0.1 mm in diameter and spaced from 10 to 13 in 2 mm. They are not markedly spool-shaped but a few are wider at the top. Only in a few areas just above growth interruption surfaces is pillar structure disordered and irregular.

In tangential sections, laminae form dense concentric bands with irregular, diffused margins; pillars are visible mainly as discrete rounded dots, approximately 30 per mm^2; a few may be fused to neighbours in aligned rows but do not form conspicuous meshworks with adjacent laminae. Astrorhizae are conspicuously developed in the centres of mamelon columns and, although they may show incomplete radiating 'septa-like' partitions in some areas, the main passageway still appears to be open at the axis; however, in vertical sections the large astrorhizae are divided by a series of apparently complete, blister-like astrorhizal tabulae to form a more or less superposed vertical row of partitioned segments, with offsets at various levels of radiating canals (0.25–0.3 mm in diameter) extending into adjacent interlaminar spaces; these canals are also divided by tabulae.

Remarks. This species was originally described as *A. contortum* Ripper, 1937c but was renamed by Flügel (1959) to avoid homonymy with *A. contortum* Gorsky, 1935. Stearn (1966: 101) noted that it would be better placed in *Gerronostroma*. Species of this genus are recorded from the Ludlow to the Frasnian (Flügel & Flügel-Kahler 1968).

Fig. 9. A–D, *Gerronostroma buchanense* (Flügel, 1959), × 10; A, holotype NMV P141758 (*ex* MUGD 1611), vertical section, Buchan Caves Limestone, Heath's Quarry; B, NMV P136244 (*ex* NMV P136150), tangential section; C, NMV P141691 (*ex* MUGD 1604), vertical section; D, NMV P136247 (*ex* NMV P136152), vertical section; B–D, Murrindal Limestone, Rocky Camp Quarry. E, F, *Petridiostroma delicatulum* (Ripper, 1937c), holotype NMV P141715 (*ex* MUGD 1606), × 10, Murrindal Limestone, Rocky Camp Quarry; E, tangential section; F, vertical section.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Some of the specimens (e.g. NMV P141692–93 and P141729) have poorly developed mamelon columns, and others (NMV P136249–50, P136251–52, P136253–54, P136255–56, P141700–701, P141708, P141716 and P141750) have much of the skeletal elements thickened, presumably by secondary diagenetic alteration processes. Both these groups of specimens should, however, be regarded as conspecific, and also the finer variety of the species referred to by Ripper (1937e: 14) as having more evenly and less flexed laminae. The separation of this variant does not seem justified based on the larger collection of specimens used in the present study.

The form from Lilydale described previously by Ripper (1933) as *Actinostroma verrucosum* (Goldfuss, 1826) has very similar astrorhizae centred within mamelon columns, as does *G. buchanense*, but differs fundamentally from the latter in exhibiting colliculi.

Petridiostroma Stearn, 1992

Type species. Simplexodictyon simplex Nestor, 1966.

Remarks. Petridiostroma is a new name for *Petrostroma* Stearn, 1991 (preoccupied by *Petrostroma* Döderlein, 1892). Species assigned to this genus range from the Wenlock to the Famennian.

Petridiostroma clarum (Počta, 1894)

Figs 10A–F, 31A

Clathrodictyon clarum Počta 1894: 152, pl. 18, figs 7–8.—Ripper 1937e: 21, pl. 4, figs 3–4.—Ripper 1938: 236.—Teichert & Talent 1958: 18, 20.

?*Anostylostroma clarum*.—Cockbain 1965: 747, figs 1–2.

Anostylostroma clarum.—Flügel & Flügel-Kahler 1968: 69 (*cum syn.*).

Material. The material is from the Murrindal Limestone at Rocky Camp Quarry near Buchan, and includes previously figured (NMV P141705–06, *ex* MUGD 1605) and other specimens (NMV P136257–58, *ex* NMV P136157; P136259–60, *ex* NMV P136158; P136261–62, *ex* NMV P136159; P136263–64, *ex* NMV P136160; P141723–24). Another doubtfully assigned specimen is from near Hicks's, Murrindal (NMV P141681–82), probably from the Buchan Caves Limestone.

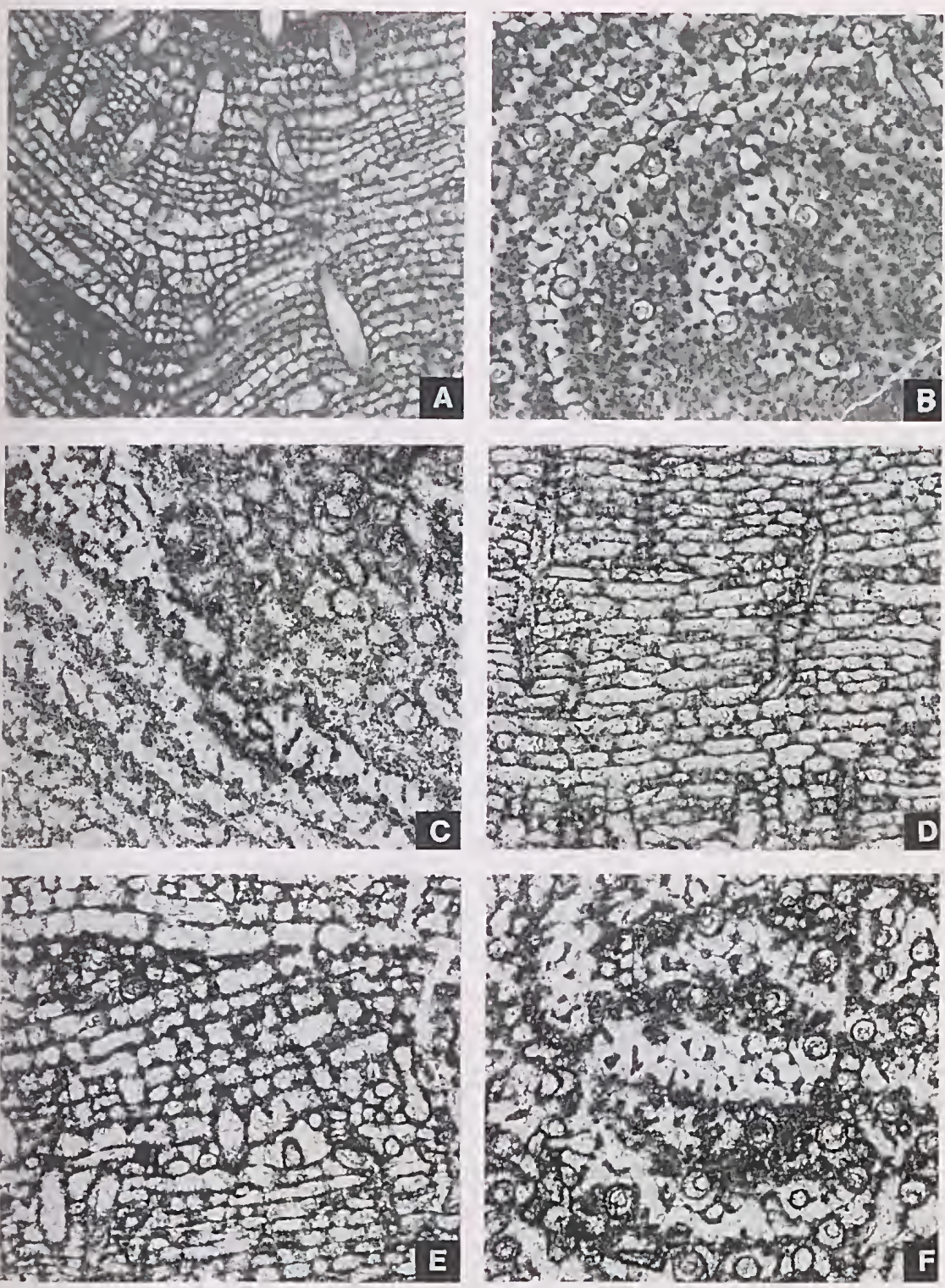
Description. The skeleton has in overall form a gently folded and banded appearance, the latilaminae being separated by thickened zones of undifferentiated skeletal material, or the skeleton is gently domical to tabular with no apparent latilamination. Syringoporoid tabulate corals, 0.3 to 0.4 mm in diameter, are commonly associated, as well as the symbiotic spiral worm tube *Helicosalpinx* Oekentorp, 1969 in one specimen (NMV P136261–62). The laminae are mostly laterally extensive but commonly unevenly spaced, from 8 to 11 in 2 mm, and from 0.03 to 0.06 (in extremes up to 0.1) mm in thickness; in a few places they show breaks in continuity, suggestive of pores, and under magnification a differentiation of layers, a darker median layer separating lighter-coloured lower and upper layers; the layers have a transverse fibrosity with minute ?pores less than 0.01 mm across.

The pillars are simple, spool-shaped (rarely superimposed), and most commonly rounded in cross section; only a few are Y-shaped; they are normally irregularly spaced throughout the skeleton; in vertical sections the most closely spaced are from 6 to 9 in 2 mm; in tangential sections they have diameters ranging from 0.05 to 0.15 (normally about 0.1) mm across; and about 12 occupy each 1 mm^2; in a few places, seemingly mainly associated with discontinuity surfaces, a phase developed in which the pillars are irregular to vermiform, or form irregular networks between successive laminae. Small cyst-like dissepiments are commonly represented in the larger interlaminar spaces, but astrorhizae are absent.

Remarks. Apart from the more conspicuous banding of skeletal material in some specimens, the Victorian material is closely similar to the type material of *P. clarum* from the Middle Devonian Koněprusy Limestone (f2) of the Prague Basin, Czech Republic. The Victorian specimens exhibit a wide range of variability in spacing of laminae and in continuity and spacing of pillars (see Figs 10A–F).

Cockbain (1965) also included specimens from the Early Devonian (?Emsian) Reefton Limestone of New Zealand in this species but they have conspicuous mamelons, 2–3 mm in

Fig. 10. Petridiostroma clarum (Počta, 1894), × 10, Murrindal Limestone, Rocky Camp Quarry; A, NMV P141705, vertical section; B, NMV P141706, tangential section; C, NMV P136258 (*ex* NMV P136157), tangential section; D, NMV 136257 (*ex* NMV P136157) vertical section; E, NMV P136263 (*ex* NMV P136160), vertical section; F, NMV P136264 (*ex* NMV P136160), tangential section.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diameter and 5–15 mm apart. Consequently the Reefton specimens are only doubtfully referrable to *P. clarum*, and may be better placed in *Petridiostroma arvense* (Parks, 1936) from the Eifelian Onondaga Formation of Ontario, a species that has well defined mamelons.

Petridiostroma delicatulum (Ripper, 1937e)

Fig. 9E–F

Clathrodictyon convictum var. *delicatula* Ripper 1937c: 20, pl. 4, figs 1–2.—Ripper 1938: 236.—Teichert & Talent 1958: 18, 20.

Clathrodictyon convictum delicatulum.—Flügel & Flügel-Kahler 1968: 103.

Material. Holotype (NMV P141715, *ex* MUGD 1606) from the Murrindal Limestone at Rocky Camp Quarry near Buchan.

Remarks. This fine-textured species is based on one small specimen intergrown with a syringoporoid tabulate coral. Laminae are laterally continous, thin and closely spaced, from 15 to 19 in 2 mm. The interconnected pillars are simple, rounded and rarely superposed, from 0.06–0.09 mm in diameter. A few large canals from 0.25–0.4 mm in diameter, seen in the tangential section, may be astrorhizal structures but these are difficult to differentiate from the connecting tubules of the associated syringoporoid coral.

Petridiostroma sp.

Fig. 11A–B

Clathrodictyon regulare (Rosen, 1867).—Ripper 1937a: 2, pl. 1, figs 1–2.—Ripper 1938: 236 (*partim*.).

non *Clathrodictyon regulare*.—Ripper 1937c: 16, pl. 1, figs. 1–2.

Anostylostroma sp. nov. A.—Philip 1962: 129.

Material. One previously figured specimen (NMV P141827–28, *ex* MUGD 1599), and three other specimens (NMV P141814–15, P141812 and P141818) from the Loyola Limestone at Griffith's Quarry, about 17 km south of Mansfield.

Remarks. The Loyola specimens are poorly preserved and too incomplete to resolve all skeletal features and details of microstructure. Consequently the species is left in open nomenclature. The original assignment of the material to *Clathrodictyon regulare* is unjustified given that the type material from the Llandovery of Estonia, revised by Nestor (1964), has a much finer texture, with 18 laminae and 14 pillars spaced in 2 mm, as compared with the spacing in the Loyola specimens of 7–9 laminae and 6–8 pillars in 2 mm. The Loyola species has continuous and relatively evenly spaced laminae (about 0.1 mm thick), in gross form regularly undulose, and simple, rounded, only rarely superposed pillars, also about 0.1 mm in diameter. These Loyola specimens do not show upwardly branching and spreading pillars, and scattered pores penetrating the laminae, as in *Anostylostroma* (see Stearn 1991).

Clathrodictyon Nicholson & Murie, 1879

Type species. *C. vesiculosum* Nicholson & Murie, 1879.

Clathrodictyon sp.

Fig. 12F

Clathrodictyon confertum Nicholson, 1889.—Ripper 1937c: 18, pl. 3, fig. 3.

Material. One specimen (NMV P141740–41, *ex* MUGD 1607) from the Buchan Caves Limestone, Martin Cameron's Quarry near Buchan. NMV P141741 was previously figured by Ripper (1937c) as pl. 3, fig. 3.

Remarks. This specimen exhibits the highly inflected laminae of a true *Clathrodictyon* but should not be grouped with *Clathrodictyon confertum* from the Middle Devonian of south Devon, England, which has a much more finely textured vesicular mesh of laminae and infleeted pillars within regularly spaced, 1 mm thick latilaminae.

Clathrodictyon? heathsense sp. nov.

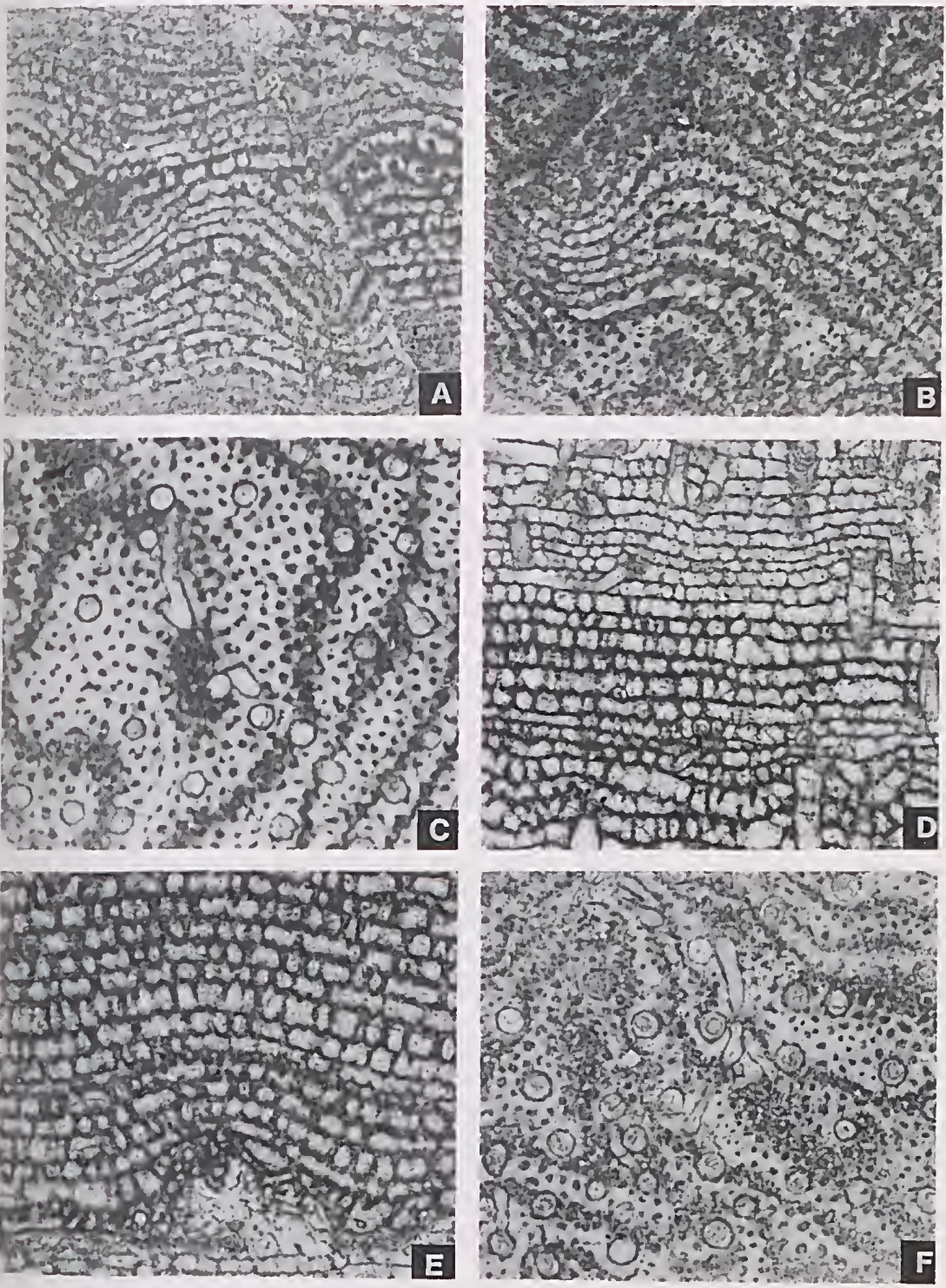
Figs 11C–F, 12A

non *Clathrodictyon convictum* Yavorsky 1929: 91, 105, pl. 6, fig. 10, pl. 9, figs 5–7.

Clathrodictyon convictum.—Ripper 1937c: 19, pl. 3, figs 4–8.—Ripper 1938: 236.—Teichert & Talent 1958: 16.—Philip 1960: 153.

aff. *Clathrodictyon regulare* (Rosen, 1867).—Ripper 1937c: 16, pl. 3, figs 1–2.

Fig. 11. A, B, *Petridiostroma* sp., × 10, Loyola Limestone, Loyola; A, NMV P141827 (*ex* MUGD 1599), vertical section; B, NMV P141828 (*ex* MUGD 1599), oblique section. C–F, *Clathrodictyon*? *heathsense* sp. nov., × 10, Buchan Caves Limestone, Heath's Quarry; C, holotype NMV P141799 (*ex* MUGD 1616), vertical section; D, paratype A NMV P141769 (*ex* MUGD 1613), tangential section; E, paratype A NMV P141770 (*ex* MUGD 1613), vertical section; F, holotype NMV P141798 (*ex* MUGD 1616), tangential section.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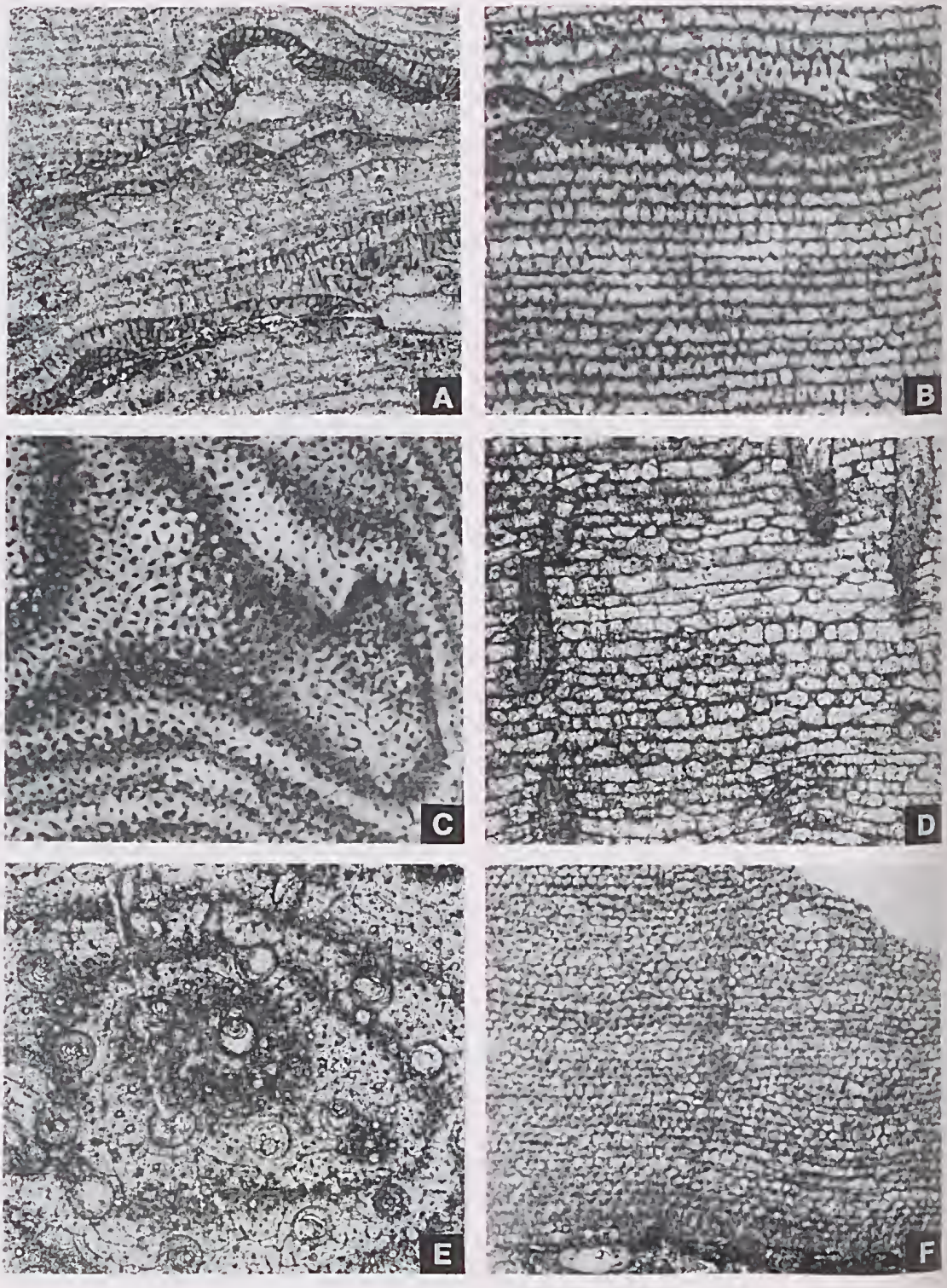
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non *Simplexodictyon convictum*.—Nestor 1966: 26, pl. 9, fig. 1; pl. 10, figs 1–2.
non *Petrostroma convictum*.—Stearn 1991: 618.

Material. Holotype (NMV P141798–99, *ex* MUGD 1616), and nine paratypes (NMV P141769–70, *ex* MUGD 1613; NMV P136273–74, *ex* NMV P136163; NMV P136275–76, *ex* NMV P136164; NMV P136277–78, *ex* NMV P136165; NMV P136279–80, *ex* NMV P136166; NMV P136281–82, *ex* NMV P136167; NMV P136283–84, *ex* NMV P136168; NMV P136285–86, *ex* NMV P136169; NMV P136287–88, *ex* NMV P136170) from the Buchan Caves Limestone, Heath's Quarry, near Buchan. Specimens MUGD 1613 and NMV P136164 are designated as paratypes A and B respectively.

Derivation of name. After the locality name, Heath's Quarry.

Diagnosis. This species has laminae inflected upwards and downwards, spaced from 6 to 10 in 2 mm, ring as well as post-like pillars, and a transversely fibrous and minutely porous to compact microstructure.

Description. Specimens are fragments of low domical skeletons estimated to be at least 150 mm in diameter and 90 mm in height. In vertical sections the laminae are broadly continuous, relatively evenly spaced, and gently undulating, in a few skeletons with crests 10 mm or more apart. Laminae may exhibit small-scale crumpling associated with intersecting spool-shaped and ring-pillars, and gentle downflexing at contacts with the associated syringoporoid (caunopore) tabulate coral; individual laminae are from 0.03 to 0.07 (typically 0.05) mm in thickness, and they are spaced from 6 to 10 (most commonly 7–8) in 2 mm. Laminae do not show a tripartite or ordinicellular structure but seem mainly to be transversely fibrous and minutely porous to compact in texture.

Latilaminae not conspicuously developed, but in one paratype (B, NMV P136164) they are from 3 to 6 mm thick; they are defined either by bands of more closely spaced or thickened laminae, or by marked disruptions to growth; a distinctive initial phase forms at the base of a latilamina after such growth interruption, with the development of finer, branching pillar-like elements similar to those seen in *Schistodictyon*. In the latilaminate specimen NMV P136164 these prominent fine branching elements show on-lapping relationships through successive initial layers as the organism recolonized over the former growth surface (Fig. 12A).

Pillars are rarely superposed throughout the skeleton, and comprise solid, simple, rod-like elements as well as ring pillars formed from inflections of laminae into pillars, both upward and downward; the pillars range from 0.08 to 0.12 mm across and have a spacing from 7 to 9 in 2 mm.

In tangential sections the laminae are represented as more opaque, obliquely intersected concentric bands with scattered rounded pores up to 0.1 mm in diameter. Ring-pillars may be from 0.09 to 0.2 mm in outer dimensions, and the solid pillars, which have rounded to irregular outlines, also range from 0.07 to 0.12 mm across. Astrorhizae are not confirmed, though a possible vertical canal up to 1.3 mm across occurs in one specimen (NMV P136166). The associated syringoporoid (caunopore) tubes and their offshoots are easily distinguished by their thicker walls; they have diameters ranging from 0.2 to 0.5 mm.

Remarks. The Heath's Quarry material was assigned by Ripper (1937c) to *Clathrodictyon convictum* Yavosky, 1929 from the Upper Silurian (Ludlow) of Saaremaa island, Estonia. Revision of this species by Nestor (1966) suggested assignment to *Simplexodictyon*. However, Stearn's (1991, 1992) redefinition of this genus, now characterised by double laminae, and his introduction of *Petridiostroma* for species with 'simple planar laminae and rodlike pillars', now requires that Yavorsky's *convictum* be transferred to *Petridiostroma*.

The Victorian species assigned previously to *convictum* is distinguished from Yavorsky's (1929) *Petridiostroma convictum* in exhibiting ring-pillars and pores through the laminae. However, the rings are formed by the downward bending of laminae into pillars as in *Clathrodictyon*, as well as by the upward inflection of laminae as in *Stromatoporella*. Consequently the

Fig. 12. A, *Clathrodictyon? heathsense* sp. nov., paratype B NMV P136275 (*ex* NMV P136164), vertical section, × 7.5, Buchan Caves Limestone, Heath's Quarry. B, C, *Clathrodictyon?* aff. *heathsense* sp. nov., × 10, Buchan Caves Limestone, Heath's Quarry; B, NMV P141808 (*ex* MUGD 1618), vertical section; C, NMV P141809 (*ex* MUGD 1618), tangential section. D, E, *Clathrodictyon?* cf. *heathsense* sp. nov., × 10, Murrindal Limestone, roadside between Buchan and Murrindal; D, NMV P136289 (*ex* NMV P136171), vertical section; E, NMV P136290 (*ex* NMV P136171), tangential section. F, *Clathrodictyon* sp., NMV P141740 (*ex* MUGD 1607), vertical section, × 10, Buchan Caves Limestone, Martin Cameron's Quarry.

species appears to be transitional between the two genera, though, on the basis that it lacks true ring-pillars and the laminae composed of tripartite, ordinicellular skeletal material, it is retained questionably in *Clathrodictyon*.

Two other similar specimens from the Buchan area were referred by Ripper (1937c: 16) to *Clathrodictyon regulare* (Rosen, 1867). In her description of the species she referred to the appearance of the pillars as 'sometimes tubular' and 'as rings' in tangential section, recalling *Clathrodictyon calamosum* Ripper, 1933 (revised herein to *Tubuliporella calamosa*) from the Lilydale Limestone. Clearly this is a reference to ring-pillars and, overall, apart from the lack of an association with the syringoporoid ('caunopore') corals, these specimens are similar to *C.? heathsense*. Both the previously figured specimen (NMV P141808–09, *ex* MUGD 1618) from Heath's Quarry (Fig. 12B–C), and another (NMV P141677–78), probably also from the Buchan Caves Limestone near Hicks's, Murrindal, exhibit rounded to elongate, solid pillars and ring-pillars, as well as pores within laminae. A few rare traces of astrorhizal canals and dissepiments are also seen in some interlaminar spaces, and similar phase changes of finer, branching, pillar-like elements in the basal layers of latilaminae. These features are not typically represented in the type material of *C.? heathsense*; consequently, the specimens are assigned separately as *C.?* aff. *heathsense*.

An additional, well preserved specimen (NMV P136289–90, *ex* NMV P136171) from the Murrindal Limestone at the roadside (L4) locality between Buchan and Murrindal exhibits alternations of more laterally extensive, evenly and widely spaced laminae and more closely spaced, irregular and less continuous laminae (Fig. 12D–E); some have a long, low cyst-like appearance. The skeleton is intergrown with an alveolitid coral and with a syringoporoid ('caunopore') having individual corallites from 0.4 to 0.6 mm in diameter. The laminae are thin and seemingly composed of compact skeletal material. Dissepiments occupy interlaminar spaces. The pillars are either simple posts or are ring pillars formed from upwardly inflected laminae. This dissepimented form is allied with but not identical to *C.? heathsense*; hence it is referred to as *C.?* cf. *heathsense*.

Clathrodictyon? heathsense from the Buchan Caves Limestone exhibits a wide range of variability. Firstly, it exhibits ring pillars and therefore may be viewed as transitional to some of the early stromatoporellids. *Stromatoporella* cf. *granulata* and *Tubuliporella calamosa*, both from the Pragian Lilydale Limestone, are the earliest known representatives of two stromatoporellid genera. However, neither species is in a line of descent to *C.? heathsense*. Secondly, *C.? heathsense* (Buchan Caves Limestone) and *C.?* cf. *heathsense* (Murrindal Limestone) may show small inflections of laminae upwards and downwards into pillars, like those exhibited in *Petridiostroma clarum* from the Murrindal Limestone at Rocky Camp Quarry (compare Figs. 10D, 11D–E and 12D), and in this respect the forms may be related.

Clathrodictyon abnorme Yang & Dong, 1979 from the upper Emsian Guitang Member of the Beiliu Formation of Guangxi Province, South China, bears the closest similarity to the Victorian species in having similar dimensions and in exhibiting a few ring pillars, but does not show such regularly pronounced upward and downward inflections of laminae into pillars.

Family Tienodictyidae Bogoyavlenskaya, 1965 (amend. Stearn, 1980)

Schistodictyon Lesovaya, in Lesovaya & Zakharova 1970

Type species. S. posterius Lesovaya, in Lesovaya & Zakharova 1970.

Schistodictyon? cylindriferum (Ripper, 1933)

Fig. 13A–D

Clathrodictyon regulare cylindriferum Ripper 1933: 157, figs 3, 6A–B.—Ripper 1938: 236.
Anostylostroma cylindrifera.—Philip 1960: 153.

Material. Holotype (four thin sections NMV P141897–98, P141995–96; *ex* NMV P13746) is from the Lilydale Limestone at Mitchell's (Cave Hill) Quarry, Lilydale; another well preserved Lilydale specimen (thin section NMV P141867) is from the collection of F. S. Colliver. Two additional Lilydale specimens (thin sections NMV P142001, *ex* NMV P13789;

Fig. 13. A–D, *Schistodictyon? cylindriferum* (Ripper, 1933), × 10, Lilydale Limestone, Mitchell's (Cave Hill) Quarry; A, holotype NMV P141995 (*ex* NMV P13746), tangential section; B, holotype NMV P141996 (*ex* NMV P13746), vertical section; C, D, NMV P141867, vertical sections. E, F, *Atelodictyon hicksense* sp. nov., holotype, × 10, Murrindal Limestone, Rocky Camp Quarry; E, NMV P136269 (*ex* NMV P136214), vertical section; F, NMV P136270 (*ex* NMV P136214), tangential section.


A
B
C
D
E
F

and P141973—74, *ex* NMV P13774) are doubtfully assigned to the species.

Description. In vertical sections the laminae are laterally extensive, regularly spaced and slightly undulating; spaced from 9 to 12 in 2 mm, and typically 0.04 to 0.07 mm thick; apparently composed of compact (minutely speckled) skeletal material. Pillars are simple, rarely superposed, ranging from dumbbell-shaped to more conspicuously widened towards the top, and spaced from 8 to 10 in 2 mm. Dissepiments are rare within gallery spaces. Astrorhizae are conspicuous, with large horizontal canals ranging from 0.2 to 0.5 mm in diameter, with a vertical series of tubes up to 0.5 mm in diameter partitioned by a considerable number of tabulae, and associated with mamelon columns.

In tangential sections the well developed mamelon columns are spaced from 8 to 10 mm apart; the pillars are vermiform to less commonly rounded in cross section; adjacent to laminae (presumably at the tops) they form a network; rounded pillars are from 0.05 to 0.1 mm in diameter and from 0.10 to 0.15 mm apart. A ring-like cluster of seven to eight large vertical astrorhizal canals, about 1.5 mm in diameter, forms around a much finer irregularly reticulated mesh of canals and dissepiments at the centre of each mamelon column.

Remarks. Philip (1960), in reporting this taxon from the Bell Point Limestone at Waratah Bay, also raised the status of Ripper's subspecies to species rank and transferred it to *Anostylostroma*. Stearn (1991) limited the scope of *Anostylostroma*, based on the type species *A. hamiltonense* Parks, 1936, to Middle–Upper Devonian forms with non-superposed, irregularly and complexly upwardly branching pillars and simple planar laminae with scattered pores and a fibrous microstructure. Consequently *cylindriferum* is now excluded from that genus because it has compact, non-porous laminae and less complexly and irregularly upwardly branching pillars.

In cross section the pillars are commonly vermiform, though towards their bases they are rounded and near their tops they exhibit a regular network of ring-pillars. The pillars are not as regularly branched or distinctively V- or Y-shaped as in the type species of *Schistodictyon*. Nevertheless, the pillars are markedly more upwardly spreading and vermiform in cross section than in typical species of *Petridiostroma*. Consequently the species is viewed as having closer relationships with *Schistodictyon* than with *Petridiostroma*, and is therefore assigned to the former with qualification.

Stearn (1991) regarded *Coenostellodictyon* Yavorsky, in Khalfina & Yavorsky 1971, based on *Clathrodictyon krekovi* Yavorsky, 1955 from the Lochkovian of the Kuznets Basin, as a junior synonym of *Schistodictyon*, mainly on the basis of its upwardly branching pillars with cylindical bases. However, it does not exhibit the complexly branching pillars of the type species of *Schistodictyon*, and in this respect more closely resembles the Victorian species.

A species of *Schistodictyon* with inconspicous astrorhizae and lacking mamelons has been recorded previously from the Lower Devonian Jesse Limestone of central New South Wales (Webby & Zhen 1993).

Pseudoactinodictyon Flügel, 1958c

Type species. P. juxi Flügel, 1958c.

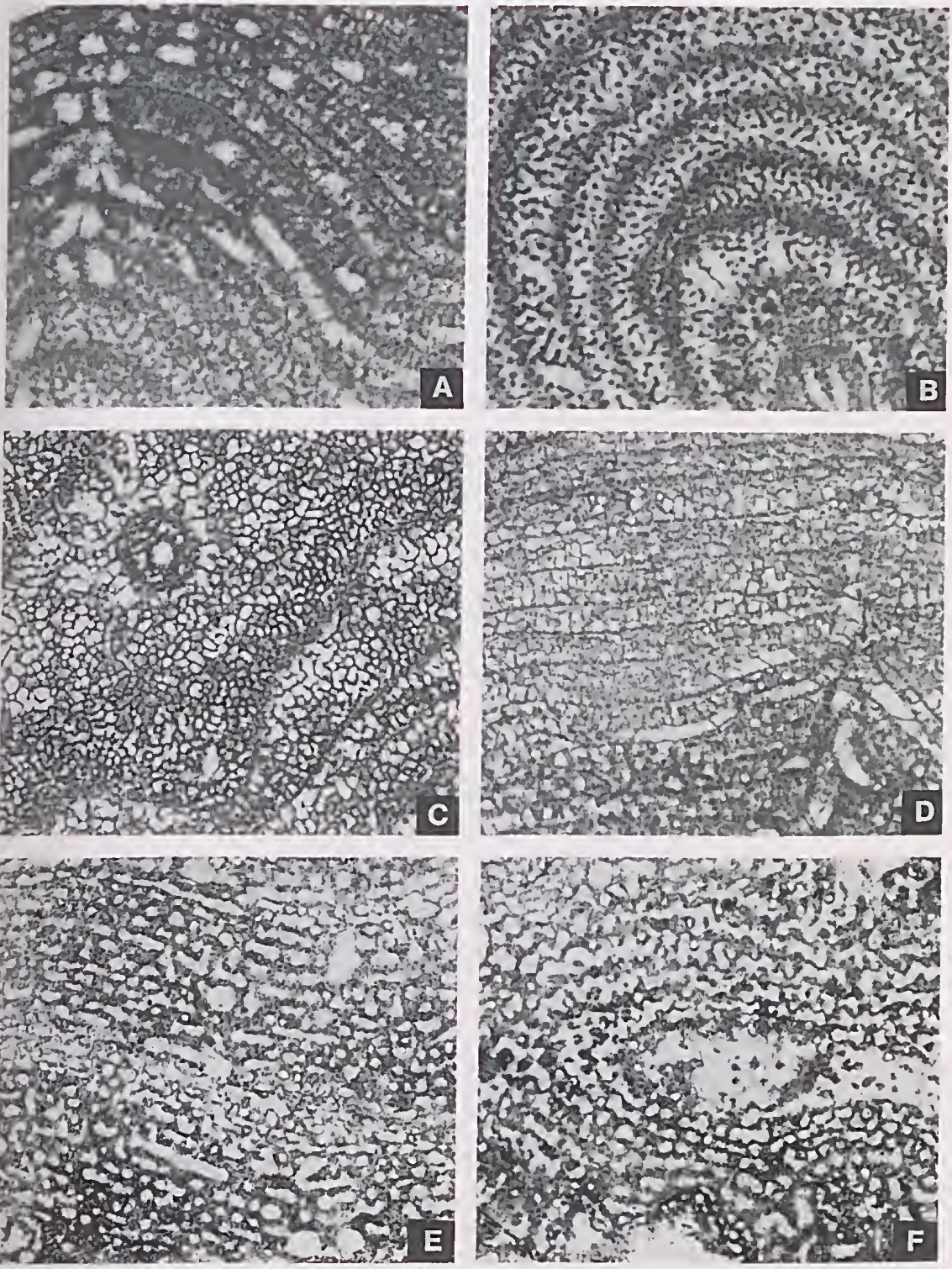
Pseudoactinodictyon sp.

Fig. 15A–F

Material. One specimen (NMV P136265–68, *ex* NMV P136161) from the Coopers Creek Limestone at Tyers Quarry.

Description. This coarse-textured species has gently undulose, mainly laterally continuous, single-layered and compact laminae, as well as abundant dissepiments in most interlaminar spaces. The laminae are from 0.06 to 0.1 mm thick and have a spacing of 3.5 to 5 in 2 mm. Large vesicular dissepiments cross a number of interlaminar spaces in a few places where the laminae are not continuous. Pillars vary from short and confined to interlaminar spaces, to long and randomly distributed through the skeleton; these latter may extend through six or more interlaminar spaces (that is, up to 5 mm

Fig. 14. A, B, *Atelodictyon* sp., × 10, Buchan Caves Limestone, Bindi; A, NMV P141940, vertical section; B, NMV P141939, tangential section. C, D, *Atelodictyon chapmani* (Ripper, 1933), holotype, × 10, Lilydale Limestone, Mitchell's (Cave Hill) Quarry; C, NMV P141900 (*ex* NMV P13747), tangential section; D, NMV P141971 (*ex* NMV P13747), vertical section. E, F, *Stromatoporella* cf. *granulata* (Nicholson, 1873), × 10, Lilydale Limestone, Mitchells's (Cave Hill) Quarry; E, NMV P141853 (*ex* MUGD 1622), vertical section; F, NMV P141852 (*ex* MUGD 1622), tangential section.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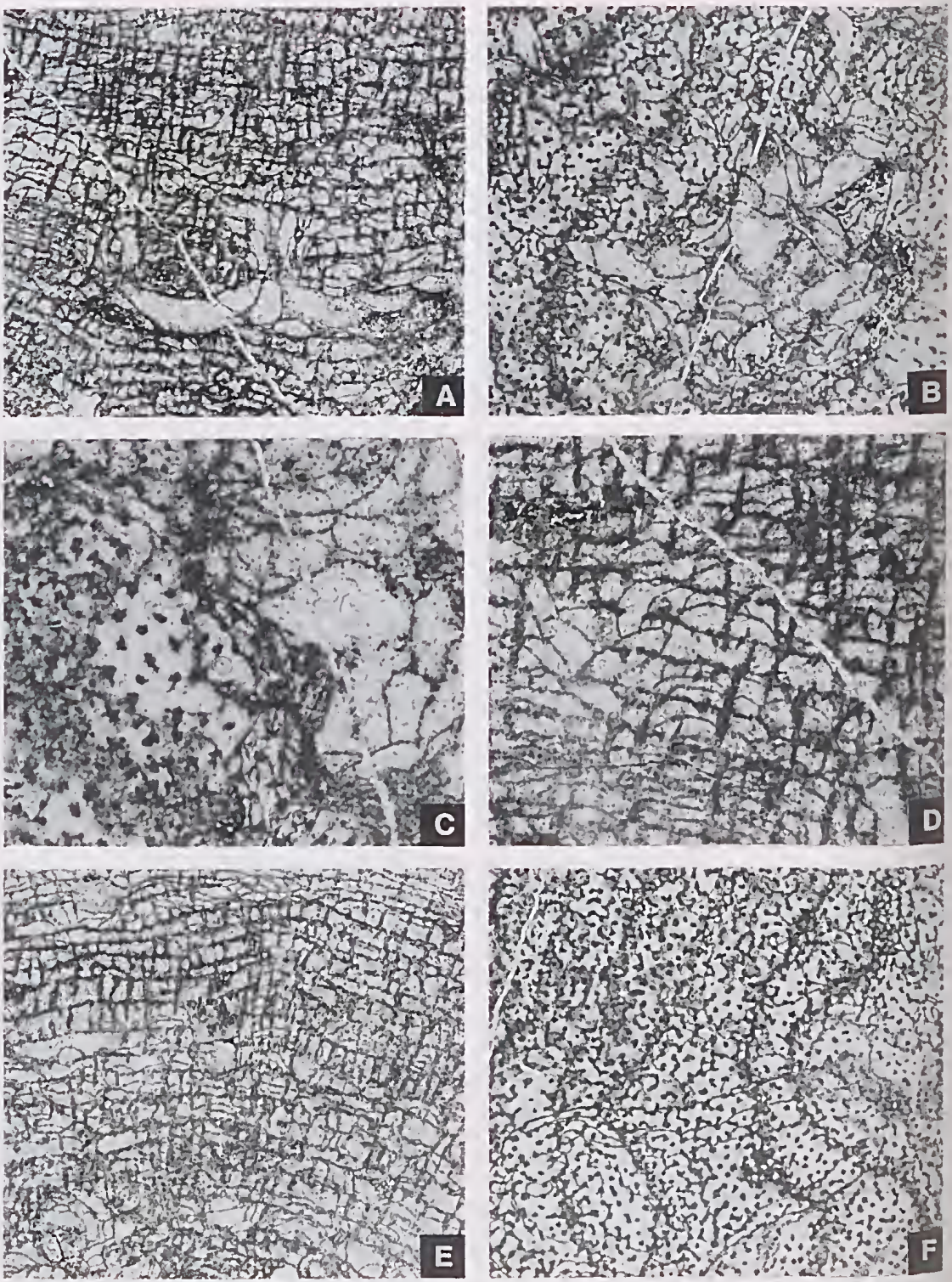
A
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vertically); typically they are from 0.1 to 0.15 mm in diameter and in a few places they also branch. Large astrorhizal canals up to 1 mm in diameter are scattered irregularly within the skeleton; they comprise radiating canals within the galleries joined to a series of superposed vertical passageways.

In tangential sections pillars are mainly rounded to irregular, from 0.1 to 0.25 mm in diameter and from 7 to 10 in 1 mm^2, but they form somewhat irregular and incomplete networks beneath each laminae. The laminae are intersected as darker concentric bands with a few pores, 0.2 mm across. Some dissepiments are large, continuous across at least 4 interlaminar spaces. Astrorhizae comprise very large, complex, tabulate, vertical canals approximately 5 by 3.5 mm across and centred on very broad, low mamelon columns; and radiating canals within galleries from 0.7 to 1 mm wide, crossed by astrorhizal tabulae.

Remarks. This species is left in open nomenclature because it is represented by only one specimen. However, it has long pillars and large dissepiments which in places cross several interlaminar spaces, unlike any of the previously described Middle Devonian species (Fagerstrom 1982, Stearn 1991) and the species currently under description from the Lomandra Limestone (Emsian–Eifelian) of the Broken River Embayment, north Queensland.

Atelodictyon Lecompte, 1951

Type species. A. fallax Lecompte, 1951.

Remarks. Stearn (1991) restricted the scope of *Atelodictyon* to forms with simple, planar laminae like the type species. He excluded those with laminae composed of colliculi, these latter being included in *Aculatostroma* Khalfina, 1968b.

Atelodictyon chapmani (Ripper, 1933)

Fig. 14C–D

Clathrodictyon chapmani Ripper 1933: 159, figs 4, 6C–D.—Ripper 1938: 236.

?*Clathrodictyon* aff. *chapmani*.—Ripper 1937a: 3, figs 3—4.

Atelodictyon chapmani.—Lecompte 1951: 134.—Stearn 1966: 88.

?*Atelodictyon* (or ?*Tienodictyon*) *chapmani*.—Flügel & Flügel-Kahler 1968: 67.

Material. Holotype (NMV P141899–900, P141971–72; *ex* NMV P13747) from the Lilydale Limestone, Mitchell's (Cave Hill) Quarry, Lilydale. Three other Lilydale specimens are closely allied, namely NMV P141968–69 (*ex* NMV P13770), P37641 and P141848–49 (these latter previously referred to *Actinostroma* aff. *stellulatum*). Specimens from the possibly correlative Loyola Limestone at Griffith's Quarry near Mansfield are doubtfully referred to the species; these include Ripper's (1937a) figured specimen (NMV P141820–21, *ex* MUGD 1598) and two other specimens (NMV P141813 and P141840–43).

Description. The skeleton is domical with non-enveloping margins. Latilaminae are obscure. Astrorhizae are well developed and mainly appear to be locally associated with mamelon columns of limited relief. In vertical sections laminae are represented by laterally continuous, gently flexed and apparently single, dark, compact layers about 0.05 mm thick, but in some places they are not easily differentiated from underlying interlaminar space with secondarily thickened skeletal elements (apparently mainly coenosteles); spacing of laminae from 4 to 5 in 2 mm. A few dissepiments, and less laterally continuous secondary laminae (or microlaminae) of variable size and of irregular distribution, occur within the interlaminar spaces and link some of the vertical skeletal elements (coenosteles) in an irregular network. Coenosteles typically completely cross interlaminar spaces but in a few places may fall short of the lower parts of the spaces; not clearly superposed; and may be irregular but rarely branching; spaced from 12 to 14 in 2 mm. Astrorhizae are centred mainly on the gently upwardly domed mamelon columns, with the largest vertical tubes being up to 0.6 mm in diameter. Radiating canals present in the adjacent interlaminar spaces, from 0.2 to 0.3 mm in diameter, and crossed by dissepiments.

In tangential sections the coenosteles form an almost continuous, regular, chain-like meshwork between the laminae, that is more complete in the upper two-thirds and typically more closely spaced in the uppermost one-third of each interlaminar space. They have a wall thickness of 0.03–0.04 mm and under magnification appear as a row of small, closely-spaced,

Fig. 15. Pseudactinodictyon sp., Coopers Creek Limestone, Tyers Quarry; A, E, NMV P136268 (*ex* NMV P136161), vertical sections; B, F, NMV P136266 (*ex* NMV P136161), tangential sections; C, NMV P136267 (*ex* NMV P136161), tangential section; A, B, E, F, × 5; C, D, × 10.

rounded dots (seemingly rounded pillars in contact) rather than as a continuous wall. The distance across individual meshes ranges from 0.2 in the lower part of the interlaminar space to 0.1 mm in the upper part.

Remarks. This species was recognized previously by Lecompte (1951: 134) and Stearn (1966: 88) as belonging to *Atelodictyon*. Flügel & Flügel-Kahler (1968: 67), on the other hand, allied it doubtfully with both *Atelodictyon* and *Tienodictyon*.

The specimens from the Loyola Limestone (Ripper 1937a) may be conspecific but are much less well preserved and consequently difficult to assess. The material shows a similar meshwork of coenosteles and abundant astrorhizae in tangential section (illustrated in part by Ripper 1937a, fig. 4) but the laminae are thicker and much more closely spaced (from 8 to 10 in 2 mm). A few breaks occur in the laminae in vertical section but, given the uniformly poor preservation of the material, these may not have real significance.

Another possible species of *Atelodictyon* is recorded from Bindi (Fig. 14A–B). It was previously identified in the Museum of Victoria collections as *Clathrodictyon bohemicum* Počta, 1894 and includes NMV P141938–40, P37639–40 (*ex* NMV P13795). It differs from *A. chapmani* mainly in lacking the closely spaced meshwork of coenosteles, and in places it exhibits rounded pillars.

Atelodictyon hicksense sp. nov.

Fig. 13E–F

Material. Holotype (NMV P136269–70, *ex* NMV P136214) from the Murrindal Limestone, Rocky Camp Quarry near Buchan. One other specimen is designated, namely NMV P141670 from the Ripper collection, from near Hicks's, Murrindal, possibly from the Buchan Caves Limestone.

Derivation of name. From the locality Hicks's near Murrindal, in the Buchan area.

Diagnosis. Species of *Atelodictyon* with closely spaced, complete laminae as well as a few incomplete, long, low, cyst-like laminae, and incomplete to partially complete networks of vertical elements (pillars and coenosteles) except at tops of interlaminar spaces.

Description. Skeleton has laminar external growth form; holotype represented by fragmentary specimen, 150 mm across and 30 mm in height. At most levels within the skeleton the laminae are even and moderately closely spaced, from 8 to 10 in 2 mm, but in a few areas they are very closely spaced; some are not laterally continuous, having the appearance of long, low, cyst-like elements; thickness of laminae varies from 0.03 to 0.05 mm. Vertical elements (pillars and coenosteles) are commonly complete and in some places superposed through more than one interlaminar space. Locally, vertical elements are incomplete, for example at their bases, or they have branching offsets (which typically appear in vertical section as rounded dots towards the middle of interlaminar spaces). Pillars and coenosteles are spaced from 11 to 13 in 2 mm. Astrorhizae are commonly developed throughout the skeleton and are composed of randomly scattered, large, spar-filled spaces, 0.25–0.3 mm in diameter within interlaminar spaces clear of vertical elements, as well as tabulated vertical canals up to 0.4 mm wide.

Laminae are represented by dense concentric bands of skeletal material, in tangential section each layer exhibiting a fine meshwork of dark brown, closely spaced dots surrounded by solid, lighter brown skeletal material. Vertical elements cut in tangential section as pillars and coenosteles. Pillars cut as dots 0.05 to 0.08 mm in diameter interspersed with vermiform pillars and coenosteles forming incomplete networks with meshes about 0.2 mm across in the lower and middle parts of interlaminar spaces and 0.1 mm across at the top.

Remarks. This species comes from higher stratigraphic levels than *A. chapmani*. It occurs in association with *Gerronostroma buchanense* near Hicks's, Murrindal. It differs from *A. chapmani* in having thinner, more closely spaced laminae, even a few incomplete, long, low, cyst-like laminae, and it has a less completely fused network of vertical elements (pillars and coenosteles), except at the tops of interlaminar spaces.

Of the species of *Atelodictyon* listed by Stearn (1991), the type species, *Atelodictyon fallax* Lecompte, 1951 from the Middle Devonian of Belgium, is similar to *A. hicksense* but has relatively widely spaced laminae (5 to 8 in 2 mm), lacks the incomplete, long, low, cyst-like laminae, and displays more continuity of the vertical structural elements within the skeleton. *A. durum* (Khromych, 1974) from the Middle Devonian of the Omulevski Mountains, Siberia, also resembles *A. hicksense* except that it has thicker vertical elements, from 0.1 to 0.13 mm

in diameter, and lacks closely spaced, incomplete laminae.

Order STROMATOPORELLIDA Stearn, 1980
Family STROMATOPORELLIDAE Lecompte, 1951

Genus Stromatoporella Nicholson, 1886b

Type species. Stromatopora granulata Nicholson, 1873.

Stromatoporella cf. granulata (Nicholson, 1873)

Fig. 14E–F

cf. *Stromatopora granulata* Nicholson 1873: 94, pl. 4, figs 3, 3a.
cf. *Stromatoporella granulata*.—Nicholson 1891: 202, pl. 1, figs 4, 5, 14, 15, pl. 4, fig. 6, pl. 7, figs 5, 6, pl. 26, fig. 1.—Flügel & Flügel-Kahler 1968: 180 (*cum. syn.*).—Sleumer 1969: 38, pl. 24, figs 3, 4, pls 25, 26, pl. 27, figs 1, 2.—Zukalová 1971: 52, pl. 11, figs 1–4.—Fagerstrom 1982: 38, pl. 7, fig.1.—Mistiaen 1985: 122, pl. 9, figs 1–9 (*cum syn.*).
Stromatoporella granulata.—Ripper 1937b: 191, pl. 9, figs 3–5.—Philip 1962: 129, 130.
Stromatoporella cf. *damnionensis* (*sic*).—Ripper 1937a: 192, pl. 9, figs 7–8.
non *Stromatoporella granulata*.—Mallett 1970a: 36, pl. 1, figs 1-2.

Material. Two specimens (NMV P141852–53, *ex* MUGD 1622; and NMV P141929, P141999–2000, *ex* NMV P13788) from the Lilydale Limestone, Cave Hill Quarry, Lilydale. Another specimen (NMV P136271–72, *ex* NMV P136162) from the Loyola Limestone at Lime Kiln Quarry, south of Mansfield, is doubtfully included in the taxon.

Description. This species has a skeleton of variably thickened and variably spaced laminae intersected by short, spool-shaped and upwardly flexed ring-pillars. Latilaminae are defined by periodic growth interruptions, commonly at intervals of about 3 mm, and adjacent phase changes to more irregular and finer meshes. Overall the laminae have a gently to more sharply flexed form, giving rise to mamelon-like columns from about 3 to 13 mm apart. Laminae are from 0.08 to 0.13 mm thick and spaced from 8 to 11 in 2 mm. The preservation of laminae and other elements is rather poor, mainly apparently compact but with small areas of speckled (?fine cellular) skeletal material; no axial clear zone or ordinicellular microstructure was seen. Astrorhizae are composed of a somewhat irregular and randomly distributed system of horizontal canals, from 0.2 to 0.5 mm across, extending upwards into larger vertical canals up to 1.2 mm in diameter in association with mamelon columns. Ring-pillars are conspicuous in tangential section, both within interlaminar spaces and along the margins of obliquely intersected laminae, from 0.08 to 0.13 mm in inside diameter and from 0.15 to 0.25 mm in outside diameter. A few pillars are also short, solid, spool-shaped posts, from 0.08 to 0.12 mm in diameter.

Remarks. In comparison with *Stromatoporella granulata*, the Lilydale specimens have slightly finer overall texture, mamelon-like columns and, perhaps owing to the preservation of the material, lack the tripartite, ordinicellular skeletal material. The specimens are consequently assigned with qualification to this species which, notably, occurs in later, Middle Devonian (mainly Givetian) successions in North America and Europe. Ripper (1937c) originally regarded the two Lilydale specimens as belonging to separate species, on the basis that the specimen assigned to *granulata* had indubitable ring-pillars but the other did not. However, though poorly preserved, this second specimen (originally compared by Ripper to *S. damnoniensis*) also exhibits evidence of ring-pillars in tangential section (see thin section NMV P142000).

Philip (1960: 153) referred to the Lilydale occurrence of *S.* cf. *granulata* as a new variety but this has not since been formalized. He also noted its presence in the Bell Point Limestone at Waratah Bay and in the Coopers Creek Formation of the Tyers area (Philip 1962). The taxon possibly also occurs in the Loyola Limestone near Mansfield (Fig. 16A, B) but, owing to its poor preservation, this specimen is only doubtfully included in the species.

Mallett (1970a) assigned specimens from the Dip Creek Limestone Member (Eifelian) of the Broken River Formation, north Queensland, to *Stromatoporella granulata* but this determination must now be questioned. *S. granulata*, on the basis of Nicholson's original type specimen (no. 329 in the Natural History Museum, London), has a coarser texture than the north Queensland form, with thicker laminae and larger ring pillars.

Genus Stictostroma Parks, 1936

Type species. Stromatopora mammillata Nicholson, 1873, non Schmidt, 1858, = *Stictostroma mammiliferum* Galloway & St Jean, 1957.

Stictostroma sp.

Figs 16C–E, 31B

Material. One specimen (NMV P136291–92, *ex* NMV P136172) from Rocky Camp Quarry near Buchan, and two other specimens (NMV P136293–94, *ex* NMV P136173; and NMV P136295–96, *ex* NMV P136174) from locality L4 south of Murrindal School; Murrindal Limestone.

Description. The well preserved specimen from Rocky Camp shows a remarkable range of internal morphologies throughout its 19 mm of vertical latilaminar growth. It changes from disturbed and irregular basal layers to more regular, widely and closely spaced phases within its 3 to 5 mm thick latilaminae. The skeleton has a weakly mammillate form and a few associated caunopore tubes up to 0.5 mm wide. A few dome-like masses of disordered skeletal material up to 3 mm across and from 1.5 to 2 mm high occur at basal discontinuity surfaces, possibly representing material which formed around localized foreign bodies after pauses in growth.

The widely spaced regular units of skeletal material are composed of continuous, relatively evenly spaced, tripartite laminae, and well developed, post-like to upwardly expanding pillars, commonly confined to interlaminar spaces but in a few places superposed through up to four interlaminar spaces; in other places incomplete, limited to the middle to upper parts of interlaminar space. Pillars are commonly from 0.1 to 0.12 mm across and spaced up to 9 in 2 mm. The laminae show a relatively light axial zone between thicker layers above and below, and overprinted by a transversely fibrous and porous microstructure. Laminae are about 0.1 (in some places to 0.2) mm thick and spaced from 6 to 8 in 2 mm. Dissepiments are abundant.

The more closely spaced phases have laminae which are single-layered (not tripartite), from 0.03 to 0.05 mm thick and spaced from 10 to 13 in 2 mm. The pillars are from 0.08 to 0.1 mm thick.

In tangential section the laminae appear as dark concentric bands with rare pores, about 0.1 mm across. The rounded to irregular pillars are clearly demarcated from the laminae, from 0.1 to 0.2 (commonly 0.15) mm in diameter, and about 12 to 15 in 1 mm^2; but locally, presumably in closer-spaced phases, the pillars are more slender, from 0.08 to 0.12 mm. Larger interlaminar spaces have many dissipments.

Both specimens from locality L4 (e.g. Fig. 16E) have associated caunopore tubes and, though they do not show the same closely spaced latilaminae and a similar range of variability, they exhibit the same regular, tripartite laminae, spaced from 6 to 8 in 2 mm, and similarly short, post-like to upwardly flaring pillars (only rarely superposed) with dissepiments commonly occupying interlaminar spaces.

Remarks. The species is confidently assigned to *Stictostroma* despite the superposition of a few of its pillars. The species figured by Galloway & St Jean (1957, pl. 6, fig. 4) as *Stictostroma mamilliferum*, which comes from the Middle Devonian Onondaga Limestone of Ontario, is similarly shown with a few of its pillars superposed through up to four interlaminar spaces.

Genus Tubuliporella Khalfina, 1968a

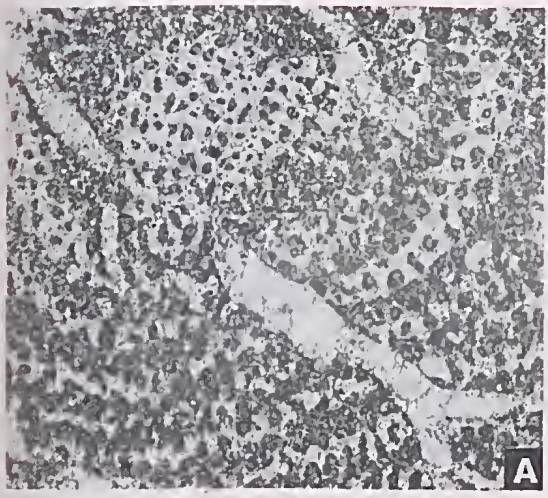
Type species. T. lecompti (*sic*) Khalfina, 1968a. Species name should be spelled *lecomptei* (*nom. correct.*).

Diagnosis. Skeleton is composed of continous laminae and superposed ring-pillars forming tubes, in places divided by tabulae and by thin, post-like pillars confined to interlaminar spaces; laminae may be upwardly(?) inflected into ring-pillars; and skeletal material is porous (amended, after Khalfina 1968a: 150).

Remarks. Khalfina (1968a) also referred to superposed astrorhizae as a diagnostic feature of *Tubuliporella*, but species she assigned to the genus, including *Stromatoporella columbusensis* Galloway & St Jean, 1957, lack astrorhizae.

Tubuliporella was distinguished from *Stromatoporella* by Khalfina (1968a) and Stearn (1980) on the basis of its long, superimposed, tube-like pillars. Three species were first recorded by Khalfina: the type, *T. lecomptei*, from the Middle Devonian (Eifelian) of Salair, and *T. altaica* and *T. tubulipilata* from the Lower Devonian of the Altai Mountains, south-west

Fig. 16. A–B, *Stromatoporella* cf. *granulata*? (Nicholson, 1873), × 10, Loyola Limestone, Lime Kiln Quarry; A, NMV P136271 (*ex* NMV P136162), tangential section; B, NMV P136272 (*ex* NMV P136162), vertical section. C–E, *Stictostroma* sp., × 10; C, NMV P136291 (*ex* NMV P136172), vertical section; D, NMV P136292 (*ex* NMV P136172), tangential section; C, D, Murrindal Limestone, Rocky Camp Quarry; E, NMV P136296 (*ex* NMV P136174), tangential section, Murrindal Limestone, roadside between Buchan and Murrindal. F, *Tubuliporella calamosa* (Ripper, 1933), paratype B NMV P141892 (*ex* MUGD 1448), vertical section, × 10, Mitchell's (Cave Hill) Quarry, Lilydale Limestone.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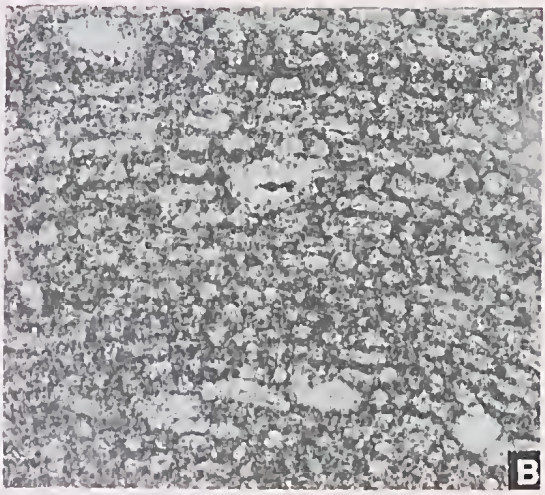
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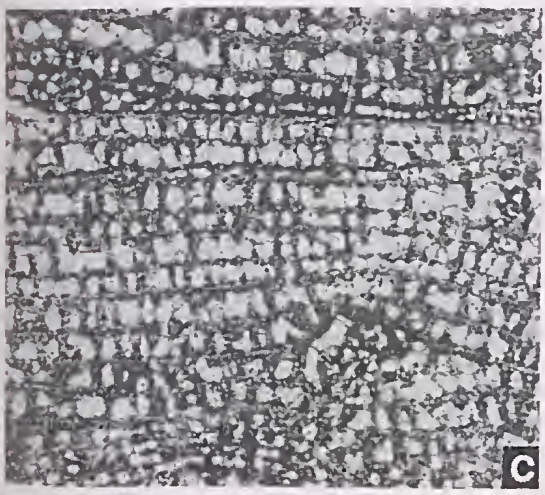
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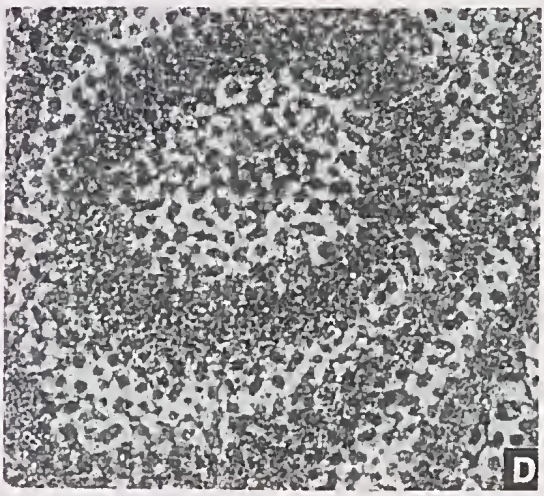
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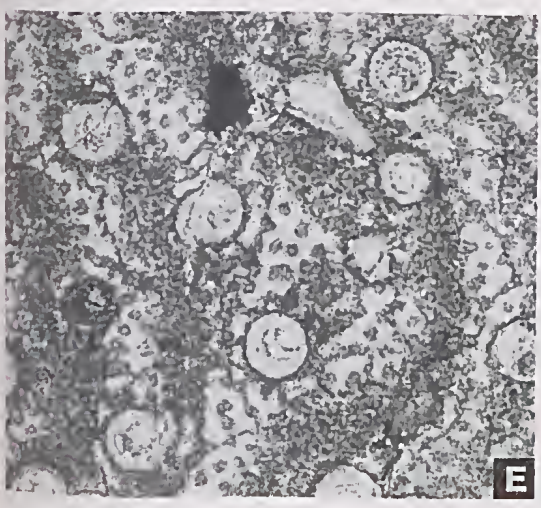
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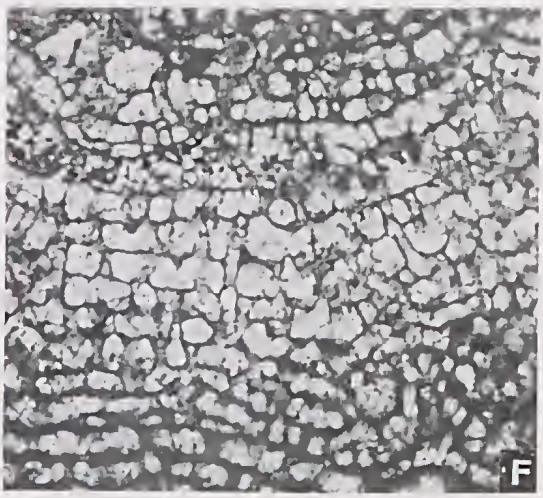
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Siberia. Two additional species (*T. kurjenskiensis* and *T. tubula*) were described by Ivaniya & Kosareva (1968) from the Middle Devonian of the Altai Mountains.

Tubuliporella calamosa (Ripper, 1933)

Figs 16F, 17A–D

Clathrodictyon calamosum Ripper 1933: 160, figs 6E–F.—Ripper 1938: 236.

Clathrodictyon? calamosum.—Flügel & Flügel-Kahler 1968: 56.

Material. Holotype (NMV P141965–67, *ex* NMV P13748), paratype A (NMV P141901–02, P141984–85; *ex* NMV P13749) and paratype B (NMV P141891–92, *ex* MUGD 1448), all from the Lilydale Limestone, Mitchell's (Cave Hill) Quarry at Lilydale. One additional Lilydale form (NMV P141893) also belongs to the species.

Description. In vertical section the laminae are commonly continous, gently undulating and in a few places deflected upwards into superposed, tube-like pillars; spaced from 6 to 9 in 2 mm; typically composed of compact skeletal material though in places becoming transversely fibrous. Laminae of variable thickness, from 0.03 to 0.1 mm (mainly from 0.05 to 0.07 mm). At the ragged outer margin of the skeleton sediment tongues from 5 to 7 mm apart project inward at the latilaminae boundaries. A few upwardly convex dissepiments occur within interlaminar spaces; typically they have thin walls from 0.02 to 0.03 mm thick. Astrorhizae not confirmed. Pillars are formed by superposition of upturned laminae (ring-pillars) extending through 3 or 4 interlaminar spaces, with tube diameters from 0.15 to 0.2 mm across and rare tabulae, and as simple post-like pillars slightly expanded at the laminae. Commonly galleries are rounded to subrectangular, ranging from 0.2 mm wide and 0.15 mm high to 0.5 mm wide and 0.3 mm high.

The tangential section shows abundant tube-like pillars developed throughout the skeleton, from 0.13 to 0.23 mm (usually 0.15–0.20) mm in diameter; these are typically spaced from 0.2 to 0.4 mm apart. Some randomly scattered solid, post-like, pillars are cut as dots from 0.05 to 0.1 mm in diameter. Scattered, large tube-like vertical structures may represent astrorhizae.

Remarks. The Victorian species from the Lilydale Limestone bears the closest resemblance to *T. altaica* Khalfina, 1968a, from the Lower Devonian succession near the mouth of the Solneshnaya River in the Altai Mountains. This latter species has 7 to 9 laminae in 2 mm, short ring pillars with diameters from 0.16 to 0.24 mm, and scattered dissepiments. The astrorhizae, described by Khalfina (1968a) as including canals in vertical rows and within interlaminar spaces, appear to be markedly more completely developed in *T. altaica* than the equivocal astrorhizal structures of *T. calamosa*. *T. tubulipilata* Khalfina, 1968a, also from the Lower Devonian of the Altai region, has more closely spaced laminae (9–13 in 2 mm) and apparently longer, superposed ring-pillars.

Genus Dendrostroma Lecompte, 1952

Type species. Idiostroma oculatum Nicholson, 1886b.

Remarks. This genus was introduced by Lecompte (1952) to accommodate dendroid to cylindrical forms previously assigned to *Idiostroma* but differing from members of that genus in having pillars chiefly confined to interlaminar spaces. Stearn (1966) noted the internal structure of *Dendrostroma* to be in some respects comparable to that of *Stromatoporella* or *Stictostroma*.

Dendrostroma? sp.

Figs 17E–F, 18A–C

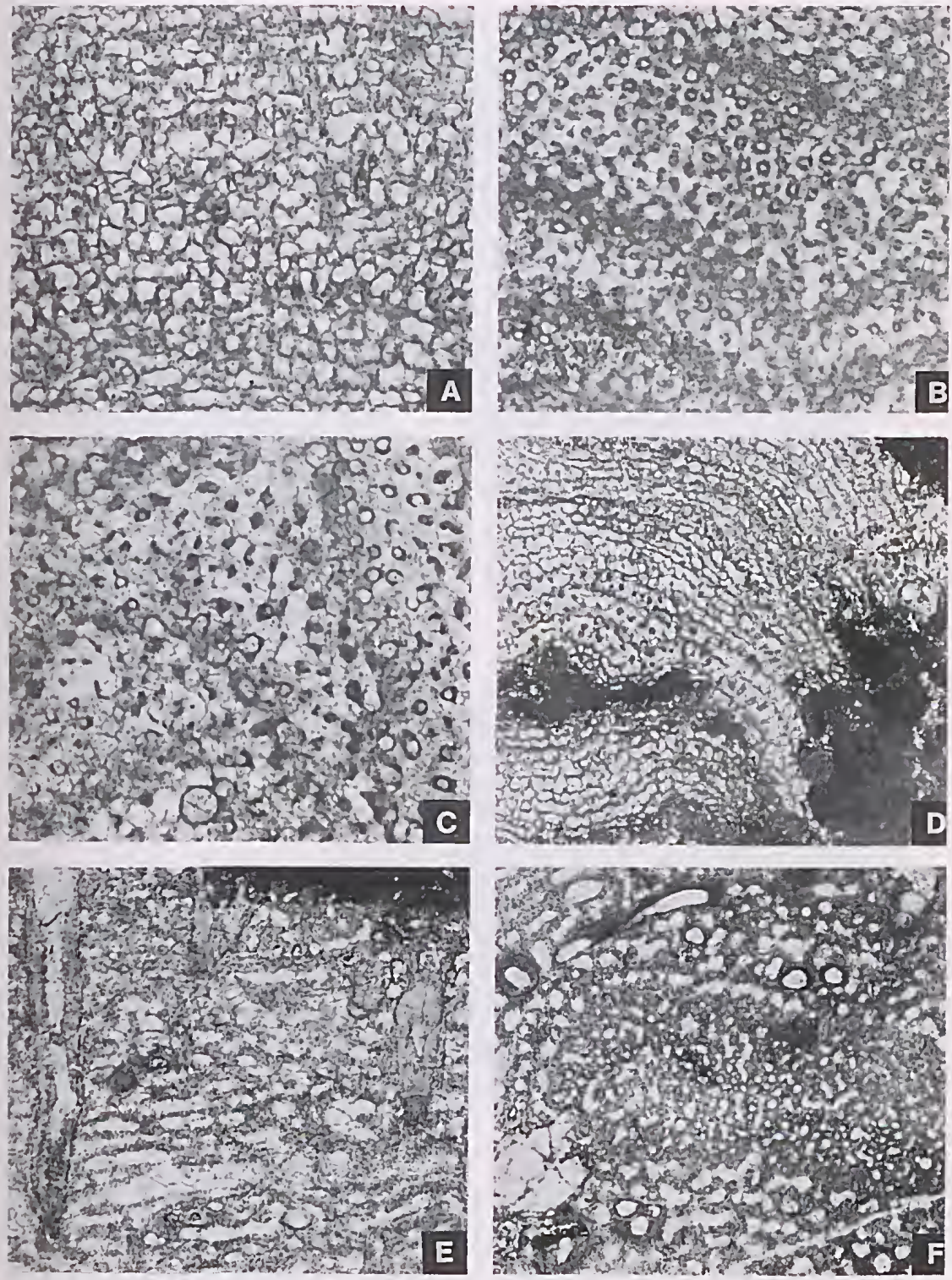
non *Idiostroma oculatum* Nicholson 1886b: 101, figs 14–15.—Nicholson 1892: 225, figs 32–33, pl. 29, figs 8–11.

Idiostroma oculatum.—Ripper 1937b: 195, text-fig. 4, pl. 9, fig. 6.—Ripper 1938: 236.

non *Dendrostroma oculatum.*—Lecompte 1952: 320, pl. 61, fig. 1.

Material. Five specimens from the Lilydale Limestone at Mitchell's (Cave Hill) Quarry, Lilydale: NMV

Fig. 17. A–D, *Tubuliporella calamosa* (Ripper, 1933), Lilydale Limestone, Mitchell's (Cave Hill) Quarry; A, holotype NMV P141967 (*ex* NMV P13748), vertical section; B, holotype NMV P141966 (*ex* NMV P13748), tangential section; C, paratype A, NMV P141901 (*ex* NMV P13749), tangential section; D, paratype A, NMV P141984 (*ex* NMV P13749), vertical section showing irregular, ragged, external margin; A–C, × 10; D, × 5. E, F, *Dendrostroma*? sp., × 10, Lilydale Limestone, Mitchell's (Cave Hill) Quarry, Lilydale; E, NMV P141957 (*ex* NMV P13766), transverse section of outer part of lateral zone; F, NMV P141958 (*ex* NMV P13767), transverse section of axial column and inner lateral zone.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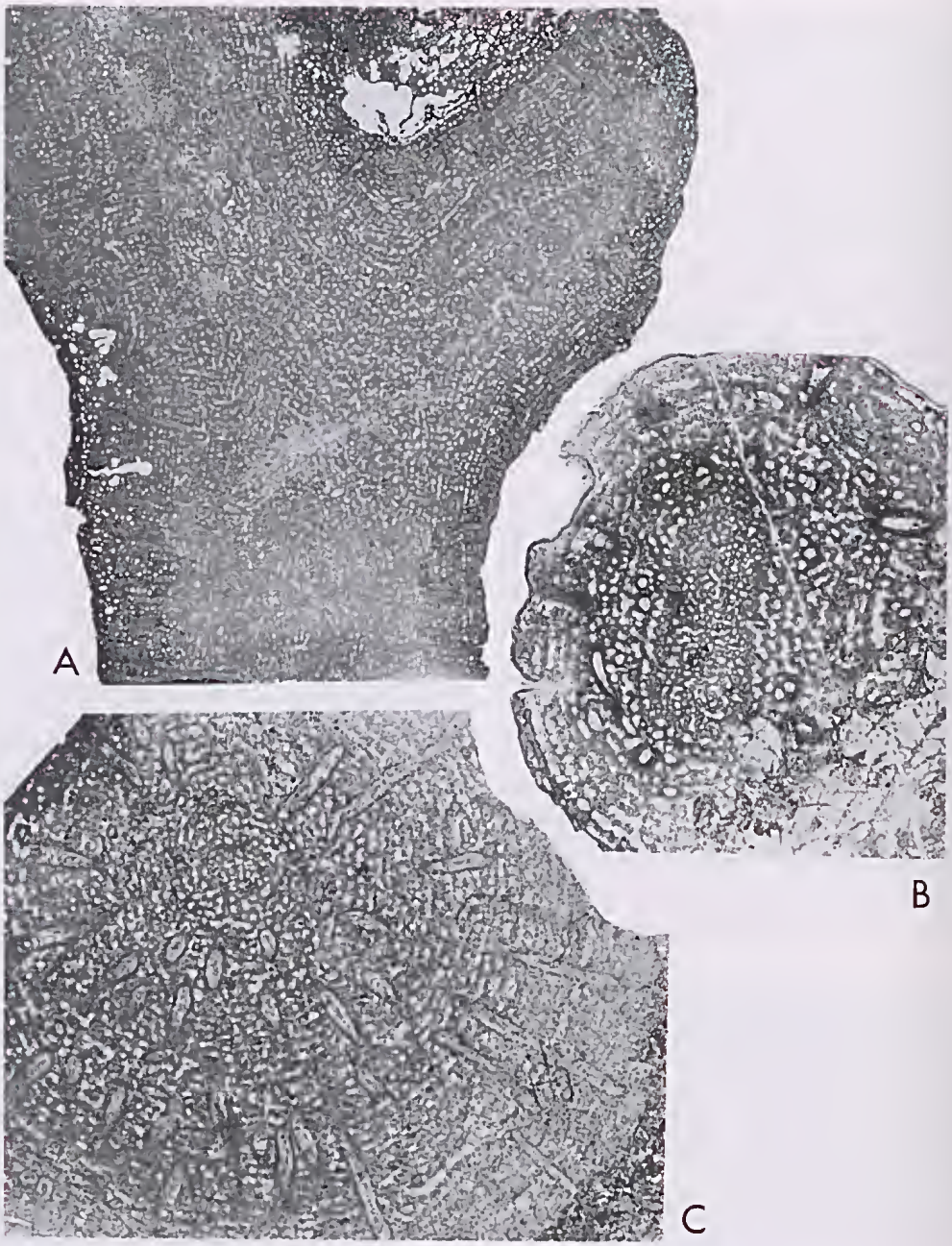


Fig. 18. A–C, *Dendrostroma*? sp., Lilydale Limestone, Mitchell's (Cave Hill) Quarry, Lilydale; A, NMV P136403 (*ex* NMV P13779), longitudinal section showing dichotomously branching specimen, × 2; photograph taken from cellulose acetate-peel replica of acid-etched specimen rather than from thin section (as are all the others); the porous nature of the lateral margins of the specimen prevented replicas made by this technique being entirely free of air bubbles (see especially midway along left margin of this illustration); B, NMV P141958 (*ex* NMV P13767), transverse section, × 5; for detail of axial column see Fig. 17F; C, NMV P141916 (*ex* NMV P13779), transverse section, × 5.

P141956–57 (*ex* NMV P13766); NMV P141958 (*ex* NMV P13767); NMV P136403–10, P141916, P141980 (*ex* NMV P13779); NMV P141919, P141986 (*ex* NMV P13781); and NMV P136411–12, P141934, P142005–06 (*ex* NMV P13792).

Description. The cylindrical-dendroid skeleton is from 10 to 25 mm across and exhibits a clear differentiation into two parts: a finer-textured axial region, which is rarely associated with caunopore tubes; and a much larger lateral zone with the characteristic *Dendrostroma* morphology and abundant associated caunopore tubes (syringoporoid coral), from 0.4 to 0.7 mm in diameter. The axial region has the appearance of a fine, irregularly amalgamate meshwork, usually about 2.5 (rarely to 4.5) mm across. It is best developed in NMV P141958 and NMV P141916, and shows in transverse section a pattern of mainly rounded to irregular or, less commonly, labyrinthine spaces from 0.05 to 0.15 mm across between the darker skeletal elements (possibly mainly intersected coenosteles); in longitudinal section this axial zone of amalgamate skeletal material can be seen to be an upwardly domed extension of laminae and pillars (or coenosteles) of the lateral zone (Fig. 18A); under magnification the skeletal material shows in one small area a cellular microstructure and in another area a melanospheric microstructure. Other specimens (e.g. NMV P141956) exhibit the melanospheric microstructure, whereas others show a coarse-cellular structure, this latter possibly being of secondary origin.

The bulk of the skeleton is composed of the lateral zone. The laminae are thick, from 0.09 to 0.2 mm in thickness, arranged in concentric layers and spaced from 7 to 8 in 2 mm; there are a few breaks in the continuity of the laminae, suggesting pores, and these seen in transverse section are rounded and 0.1 to 0.2 mm across. Details of the laminae are limited because of the poor preservation, but in a few places a thin darker axial zone is seen, suggesting a tripartite layering. The darker infill may be bituminous matter and the layers above and below, at least in one specimen (NMV P141957), appear to be composed of transversely fibrous material. In transverse section of this same specimen (NMV P141956) a very pronounced darker speckled (?melanospheric) skeletal material is exhibited, each 'speck' being from 0.02 to 0.04 mm across. Pillars (or coenosteles) are solid, spool-shaped, typically less conspicuous than the laminae, and confined to interlaminar spaces; a few, however, are also seen to be superposed through two to three laminae; in the lateral zone they seem best interpreted as pillars, from 0.1 to 0.2 mm across and with rounded to irregular cross section, but in the axial region they have a wall-like form enlosing rounded to labyrinthine spaces, confirming them as coenosteles. Dissepiments occur in larger gallery spaces, and in a few places where laminae are not continuous they may be superposed between pillars through an interval of 1 mm or so (through the equivalent of to 4 to 5 interlaminar spaces). No axial canal is present, and only a few traces of small branching astrorhizal canals have been confirmed in the lateral zone.

Remarks. The specimens are poorly preserved and consequently difficult to interpret. However, they should be excluded from the type species, *D. oculatum* from the Middle Devonian of Büchel, Germany, for none of them shows the well developed axial canal (see Lecompte 1952: 320, pl. 61, fig. 1). They may eventually prove to belong to a new taxon more closely allied to stromatoporids than to stromatoporellids (see description of *Stromatopora* sp. below), but this cannot be resolved with the available material.

Family Hermatostromatidae Nestor, 1964

Genus **Amnestostroma** Bogoyavlenskaya, 1969

Type species. Syringostroma fedorovi Yavosky, 1929

Amnestostroma holmesae sp. nov.

Figs 19A–E, 31C–D

Syringostroma aff. *ristigouchense*.—Ripper 1937b: 181, pl. 8, figs 1–2.—Ripper 1938: 236.

non *Trupetostroma tenuilamellatum* Lecompte 1952: 225.

Material. Holotype (NMV P141860–64, *ex* MUGD 1619) and six paratypes (NMV P141983, *ex* NMV P13749; NMV P141915, *ex* NMV P13778; NMV P141976–77, *ex* NMV P13776; NMV P141865–66; NMV P141874; and NMV P141873) from the Lilydale Limestone at Mitchell's (Cave Hill) Quarry, Lilydale. An additional specimen (NMV P136332–33, *ex* NMV P136226) is from the Coopers Creek Limestone at Tyers Quarry.

Derivation of name. After Elizabeth A. Holmes (neé Ripper), pioneer Victorian stromatoporoid worker.

Diagnosis. A species of *Amnestostroma* characterized by an unequally thickened grid of stout, superposed pillars and thinner, tripartite laminae locally restricted in continuity to microlaminae between pillars, or disrupted by pores;

astrorhizae common and dissepiments apparently lacking.

Description. Skeleton is broadly mammillate and exhibits a few growth discontinuity surfaces, though latilaminae are not conspicuous; in places the skeleton has associated syringoporoids (up to 0.4 mm across), rugosans (up to 3 mm in diameter) and other large tube-like organisms (up to 1.7 mm across).

Vertical sections show a well defined grid of stout, superposed pillars and much finer laminae. Pillars are spool-shaped, commonly from 0.2 to 0.3 mm in diameter, and superposed for distances of at least 7 mm vertically. Laminae are tripartite with a thin lighter axial zone, and in places ordinicellular skeletal material intervening and bounded above and below by darker microlaminae; parts of the laminae between superposed pillars may be thinner, composed of a single dark layer, or continuity is broken by scattered transverse pores. Spacing of laminae is from 12 to 14 in 2 mm. The skeletal material of the pillars and outer parts of the laminae, where associated with bituminous matter, seems to be very finely melanospheric, suggesting a vaguely cellular texture (cellules from 0.01 to 0.02 mm) but in other places (perhaps because the thin sections of these areas of the skeleton are thicker) the material seems to be transversely fibrous. The microstructure of this skeletal material does not include larger vacuoles. Astrorhizae are widely scattered through the skeleton, both as growth-parallel canals, 0.15 to 0.20 mm in diameter, and as larger, upwardly turning, irregularly stacked, 0.3 to 0.4 mm wide, tabulated chambers, and seeming to link with partitioned vertical canalways up to 0.8 mm across.

In tangential section most pillars are rounded to irregular, from 0.2 to 0.25 mm in diameter, up to 9 spaced in 1 mm^2, but some are vermiform to meandriform and grade into meshworks towards the laminae. Laminae are represented by bands punctuated by abundant rounded pores from 0.1 to 0.2 mm in diameter. Microstructure of the pillars appears finely melanospheric, probably representing finely cellular (possibly clinoreticulate) skeletal material. Astrorhizae occupy interlaminar spaces as branching, wall-less canals up to 0.2 mm across.

Remarks. Ripper (1937a) assigned this Lilydale material to *Syringostroma* aff. *ristigouchense* (Spencer, 1884) on the basis that it could be distinguished from the species in its type locality and horizon in eastern Canada by having thinner, isolated pillars instead of vertical structures 'connected by whorls of radiating fibres', and by having thinner, less uniformly grouped laminae. Lecompte (1952) subsequently placed the Lilydale form questionably in his new species *Trupetostroma tenuilamellatum*. The transfer to *Trupetostroma* is not supported herein, for the Victorian species has pillars which are thick and non-vacuolate, the laminae are equally developed and tripartite, and the astrorhizae are not conspicuous, features more characteristic of the Late Silurian–Early Devonian genus *Amnestostroma*. This genus was regarded by Stearn (1990) as an early member of the Hermatostromatidae, whereas true *Trupetostroma*, also a representative of this family, enters the record only later, during Eifelian to late Frasnian time (Stearn 1993).

Amnestostroma holmesae differs from the type species *A. fedorovi* from the Upper Silurian of the Urals in exhibiting pillars only (no coenostcles), coarser skeletal elements, and more widely spaced laminae. *A. crassum* Webby & Zhen, 1993 from the Lower Devonian of New South Wales may also be distinguished by having more laterally continous, thicker and more widely spaced laminae (4 to 7 in 2 mm as compared with 12 to 14 in 2 mm in *A. holmesae*) and more widely spaced pillars.

Order STROMATOPORIDA Stearn, 1980
Family STROMATOPORIDAE Winchell, 1867

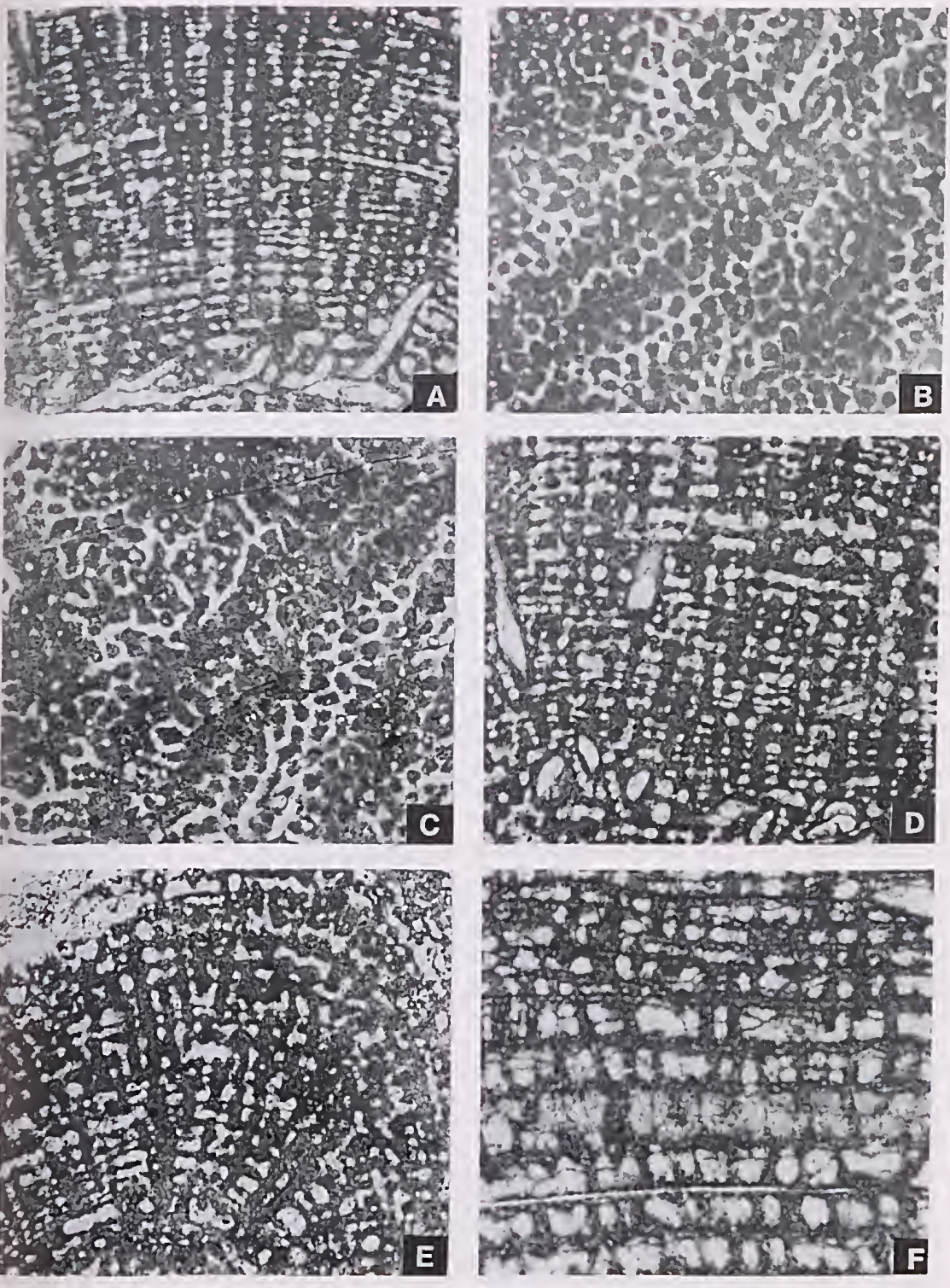
Genus **Pseudotrupetostroma** Khalfina & Yavorsky, 1971

Type species. Stromatopora pellucida var. *artyschtensis* Yavorsky, 1955.

Pseudotrupetostroma ripperae Webby & Zhen, 1993

Figs 19F, 20B–C

Fig. 19. A–E, *Amnestostroma holmesae* sp. nov., × 10, Lilydale Limestone, Mitchell's (Cave Hill) Quarry: A, holotype NMV P141861 (*ex* MUGD1619), vertical section; B, holotype NMV P141860 (*ex* MUGD 1619), tangential section; C, holotype NMV P141863 (*ex* MUGD 1619), tangential section; D, holotype NMV P141862 (*ex* MUGD 1619), vertical section; E, paratype NMV P141866, vertical section. F, *Pseudotrupetostroma ripperae* Webby & Zhen, 1993, NMV P141766 (*ex* MUGD 1612), vertical section, × 10, Buchan Caves Limestone, Heath's Quarry.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non *Hermatostroma episcopale* Nicholson 1892: 219, pl. 28, figs 4–11.
Hermatostroma episcopale.—Ripper 1937c: 29, pl. 5, figs 7–8.
Pseudotrupetostroma ripperae Webby & Zhen 1993: 340, figs 7A–F, 8C–D, 9A–B.

Material. Two well preserved specimens are from the Buchan Caves Limestone at Heath's Quarry; one (NMV P141765–66, *ex* MUGD 1612) was previously figured by Ripper (1937c), and the other (NMV P136297–98, *ex* NMV P136175) has associated caunopore tubes (0.5 mm in diameter).

Description. Coenostroms are gently undulating, relatively thick (up to 0.2 mm) and tripartite or locally cellular; less uniformly continuous, thicker lower and upper layers are separated by a continuous, thin, dark, apparently compact, median line (only 0.01–0.03 mm thick); spacing of coenostroms 4–7 in 2 mm. Pillars are similarly thick, spool-shaped elements which may be superposed or may be limited to single interlaminar spaces; range in diameter from 0.1 to 0.2 (commonly 0.15) mm and spaced from 0.1 to 0.25 mm apart (5–6 in 2 mm laterally). Mainly upwardly domed, blister-like dissepiments are common. Large vertical column of a possible astrorhizal system with septa-like radiating partitions in tangential section, up to 1.2 mm across; it is slightly offset from crest of broad, gently upwardly domed mamelon; there are few other traces of astrorhizal canals in the material under study. The coenostroms and pillars are coarsely cellular; cellules from 0.05 to 0.07 mm across. In tangential section rounded, irregular and vermiform coarsely cellular pillars are prominent. Coenostroms, where they are obliquely intersected in tangential sections, are obscurely melanospheric with vague traces of rounded pores about 0.15 mm across.

Remarks. The Heath's Quarry specimens are identical to the type specimens from the Jesse Limestone in central New South Wales. In the Museum of Victoria collections there are five other, less well preserved specimens from Heath's Quarry (NMV P136299–300, *ex* NMV P136176; NMV P136301–02, *ex* NMV P136177; NMV P136303–04, *ex* NMV P136178; NMV P136305–06, *ex* NMV P136179; NMV P136307–08, *ex* NMV P136180) and one specimen from Mitchell's (Cave Hill) Quarry at Lilydale (NMV P141935 and P142009, *ex* NMV P13793) labelled as *H. episcopale*, presumably identified by Ripper, but these are here only doubtfully assigned to *Pseudotrupetostroma ripperae*.

Pseudotrupetostroma buchanense (Ripper, 1937c)

Fig. 20A

Hermatostroma episcopale var. *buchanensis* Ripper 1937c: 32, pl. 5, figs 9–10.—Ripper 1938: 236.

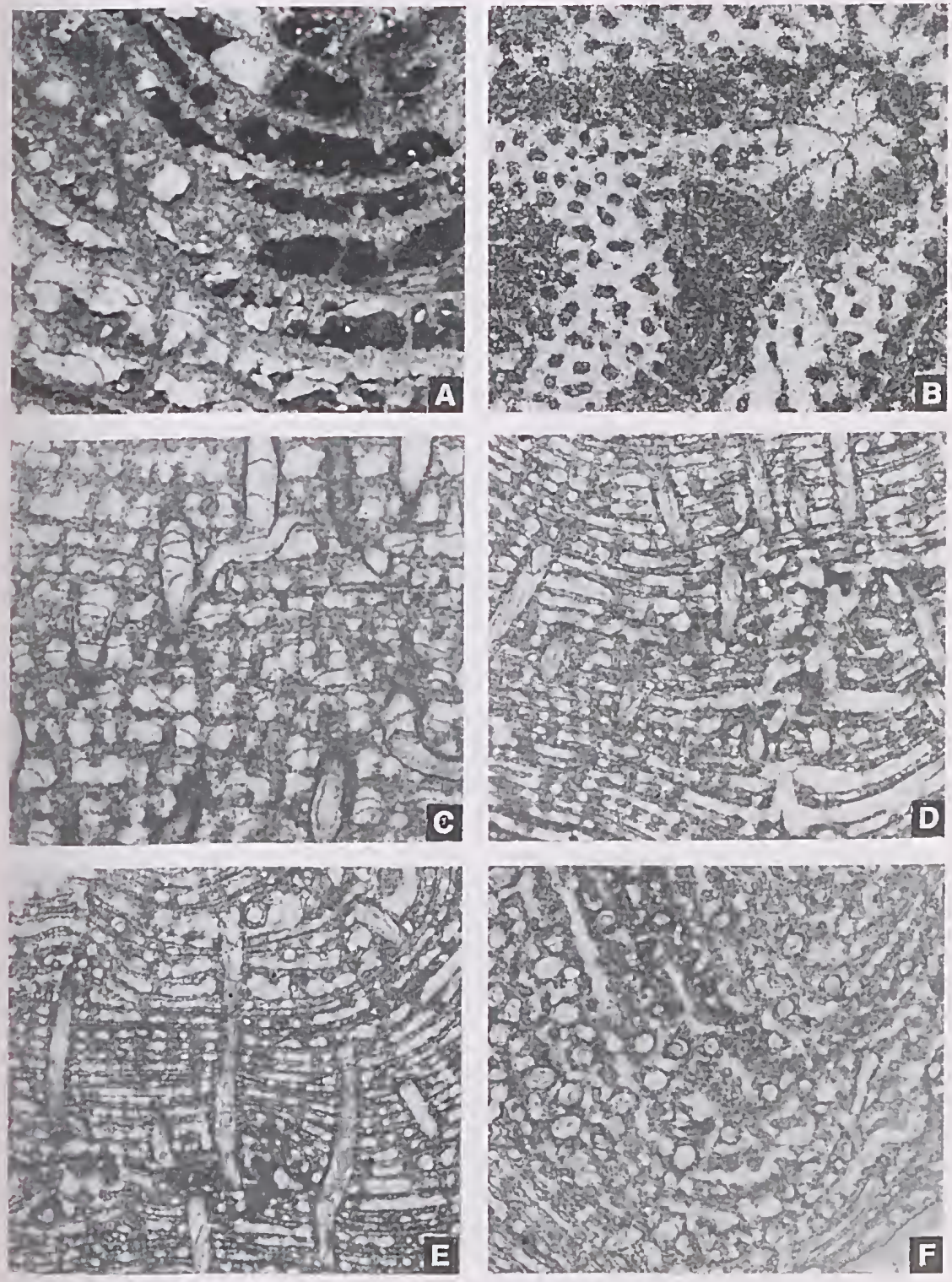
Material. Of the two designated syntypes from the locality near Hicks's, Murrindal, probably from the Buchan Caves Limestone, NMV P141671–72 (*ex* MUGD 1602) is designated lectotype and NMV P141679–80 (*ex* MUGD 1603) paralectotype; two additional specimens from this locality are NMV P141660–61 and NMV P141683.

Comparative description. Ripper (1937c) argued that the Murrindal variant *buchanensis* had a sufficiently distinctive skeletal mesh—it was more irregular and coarser—to warrant separation from the species now recognized as *P. ripperae* Webby & Zhen. The former is therefore elevated herein to species rank, though the type material is somewhat poorly preserved, as is also the additional material housed in the Museum of Victoria (see above).

In vertical section laminae broadly undulate, spaced from 2.5 to 5 in 2 mm (some laminae more than 1 mm apart), tripartite with thin median dark line, and from 0.1 to 0.3 (commonly 0.2–0.3) mm in thickness. Pillars range in diameter from 0.08 to 0.25 mm and are rarely superposed; spaced from 4 to 5 pillars in 2 mm. Dissepiments common. No astrorhizae confirmed. Cellular microstructure presumably destroyed by recrystallization.

Compared with *P. ripperae*, *P. buchanense* has more widely spaced, more wavy to irregular laminae, and slightly more conspicuous mamelons. Both species are from the Buchan Caves Limestone, though *P. buchanense* may come from a higher stratigraphic level.

Fig. 20. A, *Pseudotrupetostroma buchanense* (Ripper, 1937c), lectotype NMV P141671 (*ex* MUGD 1602), vertical section, × 10, Buchan Caves Limestone near Hicks's, Murrindal. B, C, *Pseudotrupetostroma ripperae* Webby & Zhen, 1993, × 10, Buchan Caves Limestone, Heath's Quarry; B, NMV P141765 (*ex* MUGD 1612), tangential section; C, NMV P136297 (*ex* NMV P136175), vertical section. D–F, *Pseudotrupetostroma* sp., × 10, Murrindal Limestone, Rocky Camp Quarry; D, E, NMV P141730, vertical sections; F, NMV P141689, tangential–oblique section.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Pseudotrupetostroma sp.

Fig. 20D–F

Material. Three specimens (NMV P141730–32, NMV P141687–89 and NMV P141712) from the Rocky Camp Quarry, Murrindal Limestone, near Buchan.

Description. This species shows a grid-like structure of laminae with microlaminae and superposed coenosteles (in places discrete pillars); overall the surface is gently undulose. The skeleton is associated with syringoporoid corals (caunopore tubes) from 0.3 to 0.4 mm in diameter, and with the rugosan *Lyrielasma*. Latilaminae are not conspicuous, 9 mm or more thick.

Laminae are composed of layers of coarse cellular skeletal material between laterally more persistent, dark, thin microlaminae. Most commonly the coenostroms consist of one microlamina with an underlying row of cellules, or two (as paired) microlaminae with an intervening row of cellules, and locally an additional, less laterally complete underlying row of cellules; rarely even a third microlamina may occur where laminae are closely spaced. The laminae are spaced from 9 to 11 in 2 mm and are 0.06 to 0.08 mm thick, across paired microlaminae; individual microlaminae are 0.02 mm thick, and the cellules are from 0.03 to 0.04 mm across.

Vertical structural elements are commonly superposed, and are spool-shaped or inverted cone-shaped; the vaguely speckled appearance of these vertical elements suggests a now altered but originally coarse, cellular, skeletal material like, and at the tops in continuity with, the basal row of cellules of the overlying lamina. Vertical elements are rounded to vermicular in tangential section; from 0.12 to 0.2 (in extremes to 0.3) mm in diameter. Pores in laminae were not confirmed in tangential section. Vertical dissepimented astrorhizal canals (0.4 mm in diameter) are only prominently developed in the troughs of the skeleton, where they join radiating systems of growth-parallel canals, 0.2 to 0.3 mm wide.

Remarks. The Rocky Camp species is closely similar to *P. jessiensis* Webby & Zhen, 1993 from the Limekilns area of central New South Wales but exhibits more closely spaced laminae, 9 to 11 in 2 mm as compared with 5 to 8 in 2 mm in *P. jessiensis*, and the vertical astrorhizae have a peculiar association with troughs rather than with crests in the skeleton.

These Murrindal specimens are labelled in the Ripper collection of the Museum of Victoria as '*Stromatopora concentrica* var. *colliculata* Nicholson' but were not previously included by Ripper (1937c) in her description of that taxon from the Buchan area. That material is now referred to *Coenostroma* sp. (see below).

Genus Salairella Khalfina, 1961

Type species. S. multicea Khalfina, 1961.

Salairella lilydalensis (Ripper, 1937a)

Figs 21A–F, 22A–C, 31E

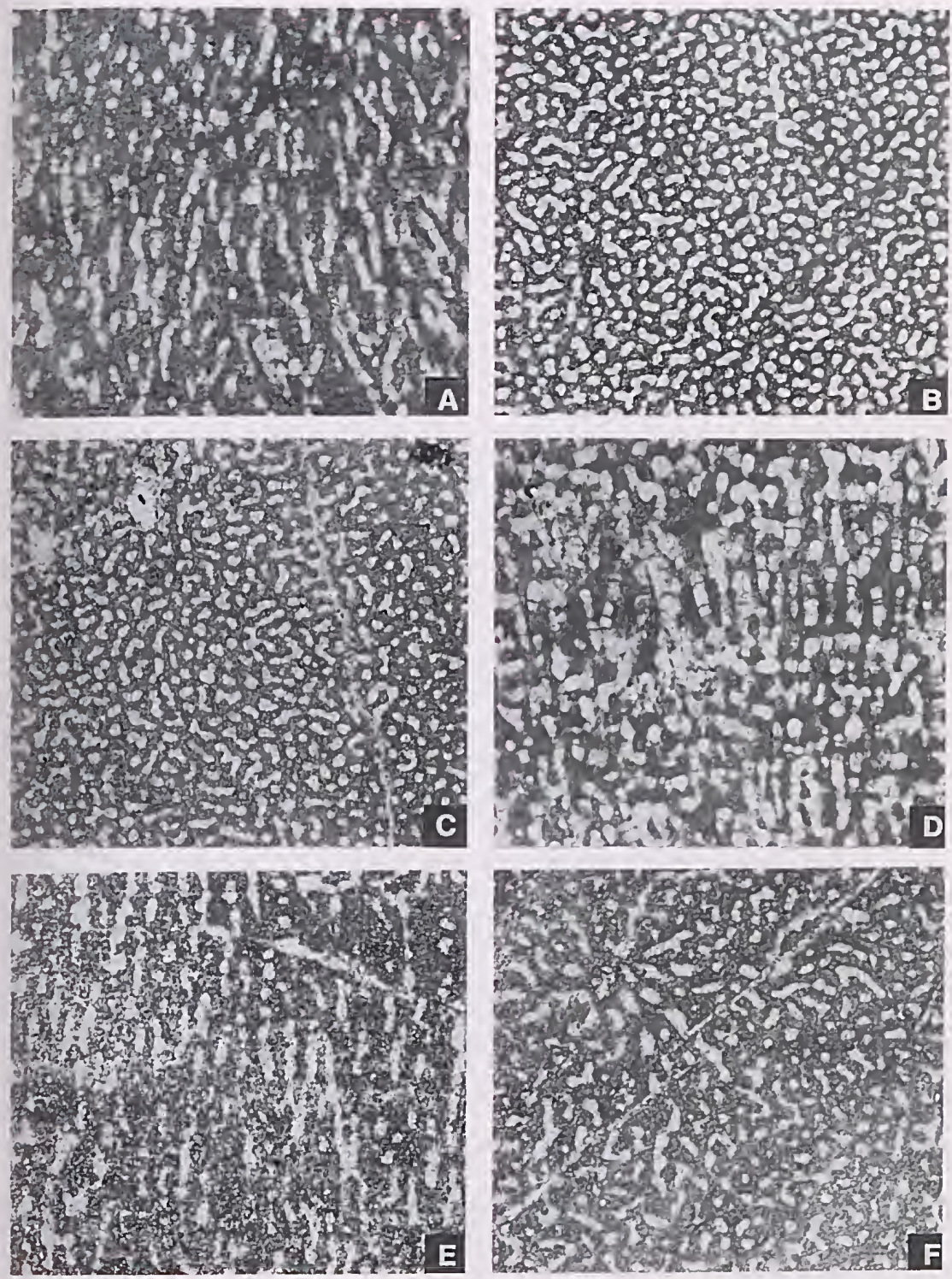
Stromatopora lilydalensis Ripper 1937a: 189, pl. 9, figs 1–2.—Ripper 1938: 236.

?*Parallelopora lilydalensis*.—Philip 1960: 153.—Philip 1962: 130.

Material. NMV P141924–25, P141992–93 (*ex* NMV P13785) is designated lectotype, and NMV P141961–62 (*ex* NMV P13768) is paralectotype; both are from the Lilydale Limestone at Mitchell's (Cave Hill) Quarry, Lilydale. The collection in the Museum of Victoria also includes NMV P141987–88 (*ex* NMV P13782), cited by Ripper (1937a: 190); NMV P141920–22 (*ex* NMV P13782), labelled in the collection as an additional syntype but not listed in Ripper's original description of the species; and four other specimens (NMV P141927–28 and P141997-98, *ex* NMV P13787; NMV P141868–70,*ex* MUGD 1621; NMV P141850–51; and NMV P141854–55); these also come from the Lilydale Limestone at the type locality. Two additional specimens (NMV P136309–10, *ex* NMV P136215; and NMV P136311–12, *ex* NMV P136216) are from the Coopers Creek Limestone at Tyers Quarry and should also be assigned to the species.

Description. In vertical sections the coenosteles are long and continuous, from 0.1 to 0.15 mm across, spaced from 7 to 8 in 2 mm, and typically diverge obliquely or join; intervening autotubes have similar dimensions, commonly from 0.1 to 0.15 mm (but in places up to 0.25 mm) across, similarly branch or join, and are crossed by horizontal to slightly upwardly domed dissepiments from 0.10 to 0.40 mm apart. Latilaminae com-

Fig. 21. Salairella lilydalensis (Ripper, 1937a), × 10; A, paralectotype NMV P141961 (*ex* NMV P13768), vertical section; B, lectotype NMV P141992 (*ex* NMV P13785), tangential section; C, lectotype NMV P141925 (*ex* NMV P13785), tangential section; D, NMV P141869 (*ex* MUGD 1621), vertical section; E, NMV P136311 (*ex* NMV P136216), vertical section; F, NMV P136312 (*ex* NMV P136216), tangential section; A–D, Lilydale Limestone, Mitchell's (Cave Hill) Quarry; E, F, Coopers Creek Limestone, Tyers Quarry.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monly but not always present, up to 8 mm thick; locally differentiated by variably spaced pauses in growth or by thickening of skeletal material. Except at the bases or tops of latilaminae, coenostroms are commonly suppressed or impersistent, usually forming as offsets of similar thickness to the coenosteles, and linked horizontally or obliquely to them, at closely or widely spaced intervals. In one specimen (Fig. 21D) coenostroms are slightly more laterally extensive at levels in the skeleton other than at the bases and tops of latilaminae; rarely associated dissepiments may be aligned to form locally persistent microlaminae. Astrorhizae are composed of clusters of inwardly and upwardly directed, tabulated canals, from 0.15 to 0.20 mm in diameter. The microstructure is composed of cellular skeletal material, the cellules being from 0.03 to 0.06 mm in diameter and, commonly in better preserved areas of the skeleton, appearing in multiply stacked rows within coenosteles and associated coenostroms.

In tangential sections the coenosteles together with obliquely intersecting coenostroms form a mainly closed amalgamate network enclosing subcircular, irregular to vermicular autotubes, from 0.1 to 0.15 mm in width. Astrorhizae occur as small radiating and branching clusters with canals up to 2.5 mm in diameter, the clusters being spaced from 4 to 8 mm apart. In a few well preserved areas, the skeletal material bounding the autotubes is composed of two or three aligned rows of rounded cellules, with darker melanospheric dots preserved in the walls bounding some cellules.

Remarks. This species exhibits considerable internal variation. In tangential sections at some levels of the skeleton the distinctive closed network of autotubes is shown, but at other levels a more irregular to vermicular pattern (?coenotubes) is more suggestive of a species of *Syringostromella* than of *Salairella*. In vertical sections the pattern of upwardly joining and dividing coenosteles also seems more typical of *Syringostromella* than of *Salairella*, but for the present the species is retained in the latter genus. It differs from *Salairella prima* from the Middle Devonian of the Omulevski Mountains of Siberia (Khromyeh 1971), and from similar material from the Lower Devonian (Emsian) of Arctic Canada (Stearn 1983) and the Jesse Limestone of central New South Wales (Webby & Zhen 1993), in having more obliquely dividing and joining coenosteles, and in having much smaller clustered astrorhizae.

Stromatopora Goldfuss, 1826

Type species. Stromatopora concentrica Goldfuss, 1826.

Stromatopora aff. polaris (Stearn, 1983)

Figs 5F, 23A–F, 24A

partim. *Stromatopora concentrica*.—Ripper 1937c: 24, pl. 4, figs 7–8 (not pl. 5, figs 1–2).

partim. *Stromatopora hüpschii*.—Ripper 1937c: 28 (not pl. 5, figs 5—6).

aff. *Ferestromatopora polaris* Stearn 1983: 551, figs 5A–D (*cum syn.*).

aff. *Stromatopora polaris*.—Stearn 1990: 507, fig. 3.8.

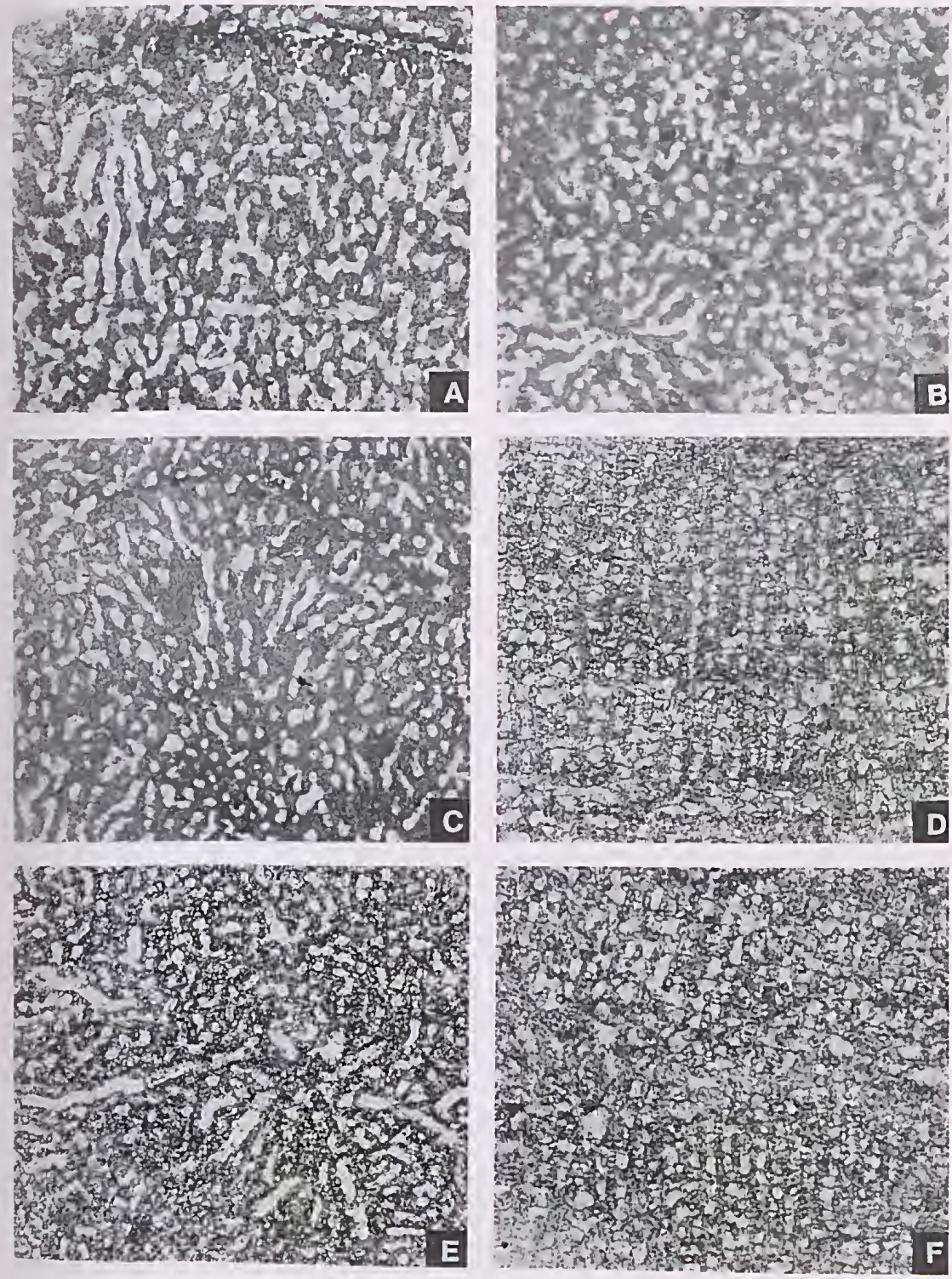
aff. *Stromatopora* cf. *Stromatopora polaris*.—Stearn 1990: 507, fig. 6.5, 6.6.

? *Stromatopora* sp.—Webby & Zhen 1993: 344, figs 10D–F, 12C–D.

Material. Specimens come from the following localities in the Buchan Caves Limestone: Heath's Quarry (NMV P141752–53, NMV P141775, NMV P141776–77); Martin Cameron's Quarry (NMV P141739), near Hicks's, Murrindal (NMV P141658–59, NMV P141662–63, NMV P141668, NMV P141673–74), and from Citadel Rocks, Murrindal River (NMV P141652–53, NMV P141656–57). Additional specimens are from the Murrindal Limestone at the Rocky Camp Quarry, near Buchan, including NMV P136326–27 (*ex* NMV P136223), NMV P136328–29 (*ex* NMV P136224), NMV P136330–31 (*ex* NMV P136225), NMV P141685–86, NMV P141719–20, and NMV P141721–22 (*ex* UGD 1608).

Description. Specimens of this strongly latilaminate species may exhibit inter-or overgrowths of tabulate corals and/or calcareous algae. The closely spaced latilaminae are defined by abrupt changes or, less commonly, interruptions to growth; latilaminae are typically from 0.5 to

Fig. 22. A–C, *Salairella lilydalensis* (Ripper, 1937a), × 10, Lilydale Limestone, Mitchell's (Cave Hill) Quarry; A, NMV P141921 (*ex* NMV P13782), vertical section; B, NMV P141868 (*ex* MUGD 1621), tangential section; C, lectotype NMV P141993 (*ex* NMV P13785), vertical section. D–F, *Parallelopora ampla* sp. nov., × 10, Murrindal Limestone, Rocky Camp Quarry; D, holotype NMV P 136313 (*ex* NMV P136217), vertical section; E, holotype NMV P136314 (*ex* NMV P136217), tangential section; F, holotype NMV P136315 (*ex* NMV P136217), vertical section.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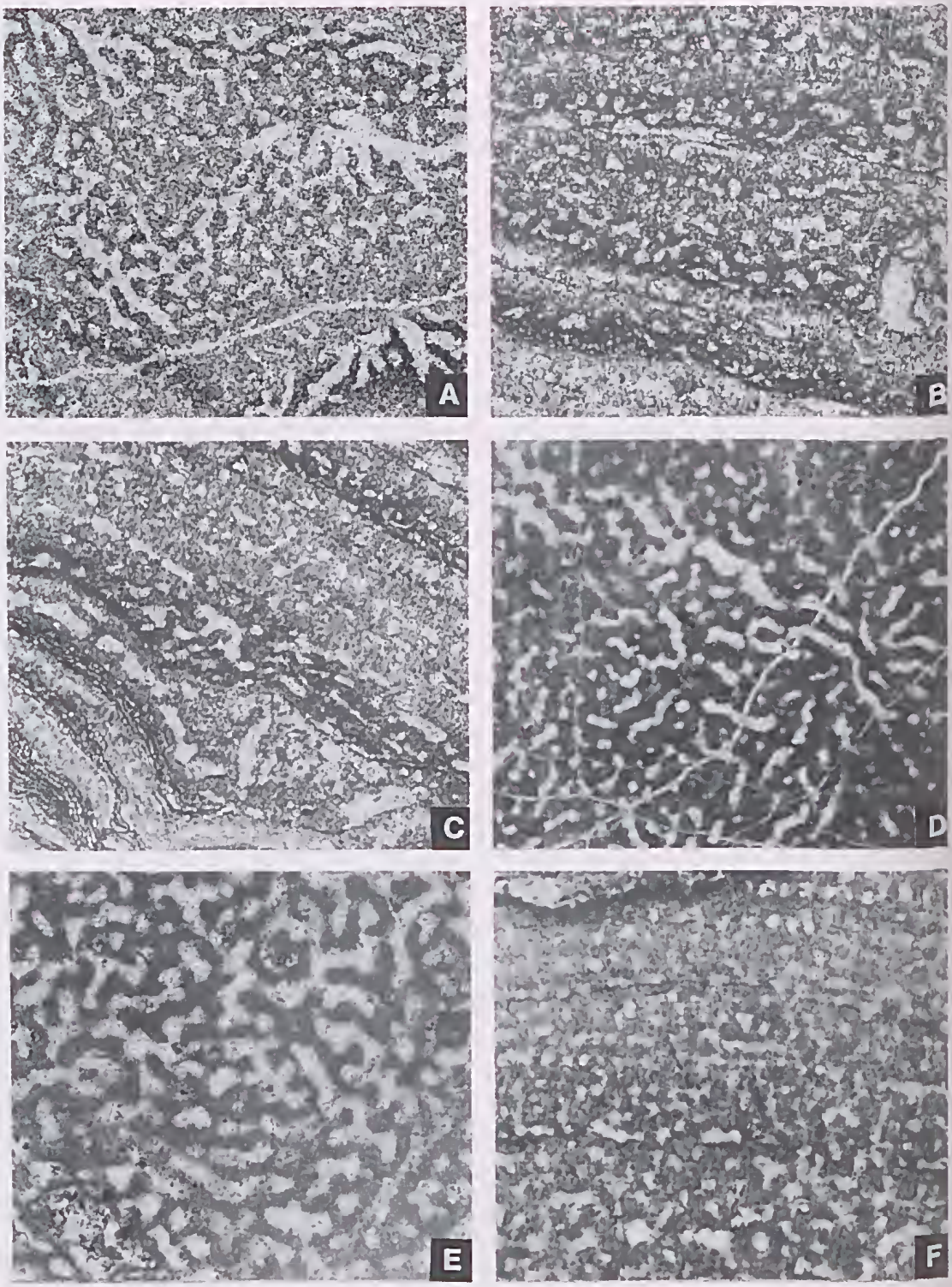
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3 mm (in extremes to 6 mm) thick. Vertical sections show amalgamate skeletal material, locally developing a cassiculate meshwork, but short coenosteles predominate in isolated areas, and coenostroms are most prominent towards the bases and tops of latilaminae. The short coenosteles are from 0.1 to 0.2 mm in diameter and spaced 7 in 2 mm; the coenostroms are also from 0.1 to 0.2 mm thick but may be thickened (up to 0.3 mm) at the tops of latilaminae. This thickening is more pronounced in some specimens than in others. Dissepiments are regularly developed across intercoenosteles (coenotubes) spaces, also in more scattered occurrences crossing transversely elongated intercoenostromal spaces, and in a few places align to form incomplete microlaminae. The larger, transversely elongate and vertically aligned spaces are probably a part of astrorhizal canals.

In tangential sections the skeleton is a completely amalgamate network, the individual coenosteles being from 0.1 to 0.2 mm wide. Coenotubes are predominantly vermiform to meandriform but are locally rounded to irregular. Astrorhizal centres are spaced about 6 to 8 mm apart, with outwardly radiating and branching, wall-less canals from 0.15 to 0.25 mm wide. Well preserved specimens have a vaguely fine cellular microstructure.

Remarks. The Buchan specimens exhibit the latilaminate growth and cassiculate structure that is characteristic of the type species, *S. concentrica* Goldfuss, 1826 from the Middle and Upper Devonian of Europe and Asia (see recent discussions in Mistiaen 1985: 134 and Stearn 1990: 506), and of *S. polaris* (Stearn, 1983) from the Lower Devonian (Emsian) of Arctic Canada. Stearn (1990) noted the great range of variability and irregularity of structure of *S. polaris*, and similar characteristics are seen in the more-or-less age equivalent Buchan specimens now allied to this species. Better preserved specimens of *Stromatopora* sp. from the Jesse Limestone of central New South Wales (Webby & Zhen 1993) may also be conspecific but they are less finely and regularly latilaminate, and have more predominantly labyrinthine galleries than in typical representatives of *S. polaris*.

Stromatopora sp.

Fig. 24B–D

Stromatopora bücheliensis.—Ripper 1937b: 187, pl. 8, figs 9–10.—Ripper 1938: 236.—Philip 1962: 5.

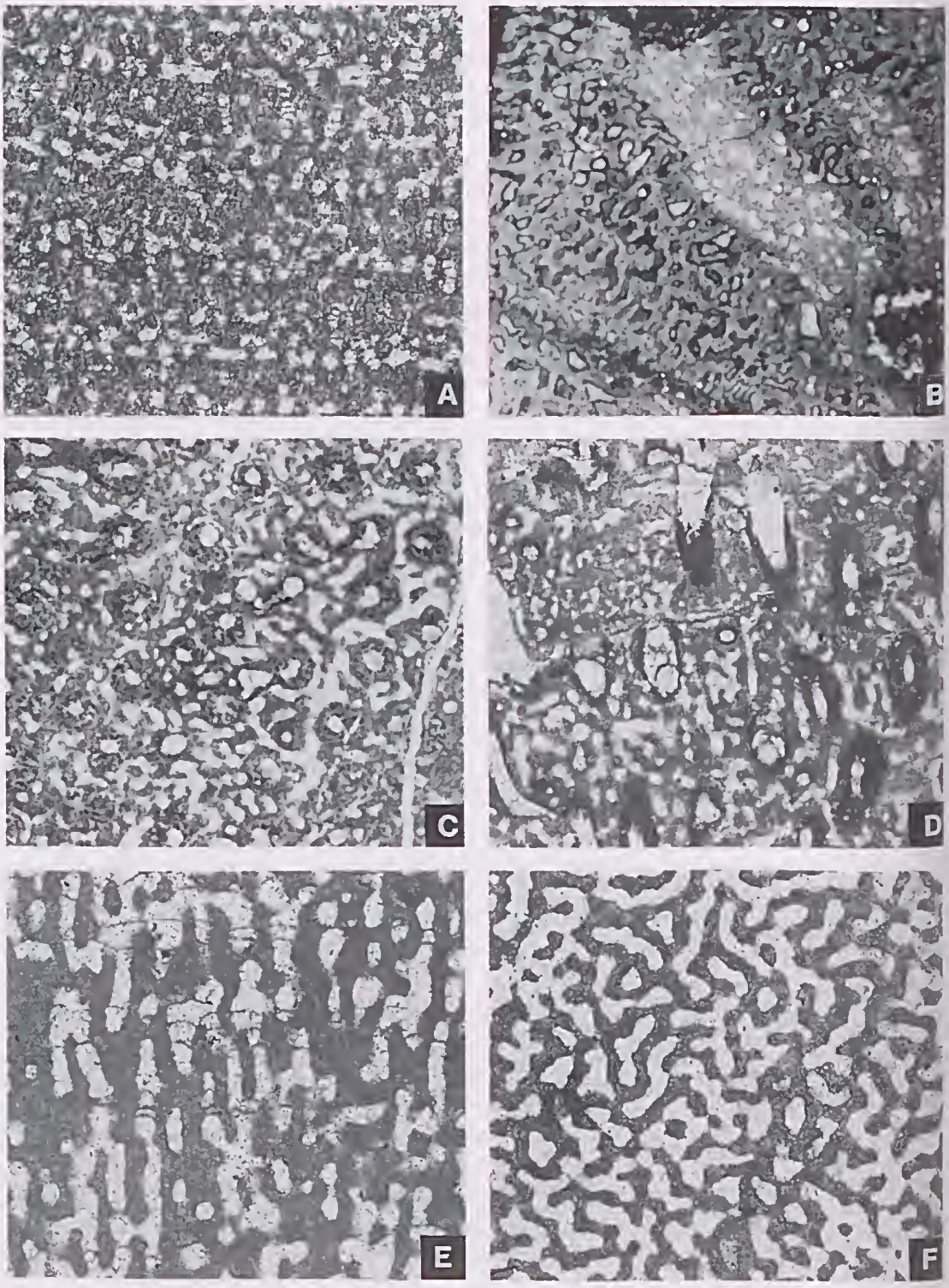
Stromatopora bücheliensis var. *digitata.*—Ripper 1937b: 188, pl. 8, fig. 6, text-fig. 3A, B.—Ripper 1938: 236.

Material. Seven specimens (NMV P141906–08, P141946–48, *ex* NMV P13763; NMV P141963–64, *ex* NMV P13769; NMV P141975, *ex* NMV P13775; NMV P141926, P141994, *ex* NMV P13786; NMV P141936–37, P142010–1, *ex* NMV P13794; NMV P37642; and NMV P141913) from the Lilydale Limestone at Mitchell's (Cave Hill) Quarry.

Comparative description. The Lilydale material assigned by Ripper (1937b) to *Stromatopora buecheliensis* (Bargatzky, 1881) and to *S. buecheliensis digitata* Nicholson, 1891 is obscured by intergrowths of caunopore tubes of syringoporoid coral affinity, but despite this, it seems to comprise a range of growth forms from domical to digitate of one rather than two species. There is a possibility that the cylindrical forms previously referred by Ripper (1937b) to *Idiostroma oculatum* Nicholson, 1886b, and now classified herein as *Dendrostroma*? sp., may also be allied, but presently these seem better included tentatively within the stromatoporellids.

The fragmentary and comparatively poorly preserved skeletons of *Stromatopora* sp. show a few breaks in growth but latilaminae are not clearly evident. The skeleton is not dominated by either vertical or horizontal structural elements, though discrete short coenosteles from 0.1 to 0.2 mm across and impersistent coenostroms of similar dimensions are locally present; the chainlink, fence-like or cassiculate structure is, however, more conspicuously developed within the skeleton where not completely disrupted by intergrowths of caunopore tubes. The gallery spaces may be either closed with rounded to elongate outlines where the chainlink is completely formed, or more open, locally labyrinthine, at some other levels; in a few areas dissepimented coenotubes, from 0.1 to 0.2 mm across, are present.

Fig. 23. Stromatopora aff. *polaris* (Stearn, 1983), × 10; A, NMV P136327 (*ex* NMV P136223), tangential section; B, C, NMV P136326 (*ex* NMV P136223), vertical sections, note that Fig. 20C shows the species in intergrowth relations with a sheet-like alga; A–C, Murrindal Limestone, Rocky Camp Quarry; D, NMV P141662, tangential section, Buchan Caves Limestone near Hicks's, Murrindal; E, NMV P141776, tangential section; F, NMV P141775, vertical section; E, F, Buchan Caves Limestone, Heath's Quarry.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In tangential sections the network is amalgamate with most commonly labryrinthine to circular gallery spaces. Astrorhizae were not identified. Because of poor preservation it is not possible to confirm whether a cellular or other type of microstructure exists, but skeletal elements show a few vague traces of melanospheric texture.

Genus Syringostromella Nestor, 1966

Type species. Stromatopora borealis Nicholson, 1891.

Syringostromella zintchenkovi (Khalfina, 1961)

Figs 24E–F, 25A–C

Stromatopora aff. *hüpschii*.—Ripper 1937a: 186, pl. 8, figs 7–8.—Ripper 1938: 236.

non *Stromatopora hüpschii*.—Ripper 1937c: 28, pl. 5, figs 5—6.—Ripper 1938: 236.—?Teichert & Talent 1958: 20.

Stromatopora zintchenkovi Khalfina 1961: 327, pl. D3, fig. 1a, b.

Material. Four specimens from the Lilydale Limestone at Mitchell's (Cave Hill) Quarry, as follows: NMV P141930–31, P142003–04 (*ex* NMV P13790, previously figured material of Ripper 1937a), NMV P141917–18, P141981–82 (*ex* NMV P13780, previously allied to *S. lilydalensis*), NMV P141911–12, P141954-55 (*ex* NMV P13765), and NMV P141882–84 (previously labelled as *S. gentilis* Gortani).

Description. This species exhibits both laminar-domical and cylindrical growth forms. The individual branches of the latter range from 7 to 18 mm across and show rare growth bands not seen in the laminar-domical form. Internally the skeleton is composed dominantly of coenosteles, from 0.2 to 0.35 mm in diameter and spaced from 4 to 5 in 2 mm. Coenostroms are mainly offsets from the coenosteles; they are equally thick but lack lateral continuity; in a few places they occur successively in closely spaced intervals between adjacent coenosteles, resulting in a few oval to rounded galleries, from 0.2 to 0.3 mm across. Thin, long, convexly arched dissepiments also occur and may, at certain levels, align to form more laterally continuous microlaminae. Most of the remaining gallery space is open and meandriform because of the mainly incomplete development of coenostroms and dissepiments. No astrorhizae have been confirmed and latilaminae are not clearly represented. Rows of cellules are in a few places vertically aligned parallel with the coenosteles and may, like a series of flow lines, curve into subhorizontal alignments at levels of successive coenostroms.

In tangential section the coenosteles and associated offsets form a vermiform to loosely labyrinthine network; only in a few areas is the maze-like network closed off with smaller rounded coenotubes from 0.2 to 0.3 mm across. Within the 0.15 to 0.3 mm wide coenosteles in the network, two or three rows of rounded to more elongate cellules are common; individually the cellules range from 0.03 to 0.05 mm (in extremes to 0.1 mm) across.

Remarks. The spacing of coenosteles, the width of structural elements, the nature of the dissepiments and their alignment at certain levels to form microlaminae, and the character of the labyrinthine networks in tangential section are all consistent with Khalfina's (1961) original description and illustrations of *S. zintchenkovi* from the Lower Devonian of Salair, southwestern Siberia. The significance of the Victorian specimens having areas of the skeleton with more open spaces (galleries and coenotubes) is difficult to assess until the limits of variation in the species are better understood.

Syringostromella cf. labryrinthea Stearn, 1990

Figs 25D–F, 32C

partim. *Stromatopora concentrica*.—Ripper 1937c: 24, pl. 5, figs 1–2 (not pl. 4, figs 7–8).

partim. *Stromatopora hüpschii*.—Ripper 1937c: 28, pl. 5, figs 5–6.

Syringostromella labyrinthea Stearn 1990: 507, figs 5.1, 5.2, 7.5, 7.6, 8.5 (*cum.syn.*)

Material. Three specimens from the Buchan Caves Limestone: two (NMV P141784–88, *ex* MUGD 1615; and NMV P141793) from Heath's Quarry, and one (NMV P141654–55, *ex* MUGD 1601) from Citadel Rocks, Murrindal River.

Description. Skeleton has latilaminae ranging from 1.5 to 8 mm (in extremes to 12 mm) in

Fig. 24. A, *Stromatopora* aff. *polaris* (Stearn, 1983), NMV P136329 (*ex* NMV P136224), vertical section, × 10, Murrindal Limestone, Rocky Camp Quarry. B–D, *Stromatopora* sp., × 10, Lilydale Limestone, Mitchell's (Cave Hill) Quarry; B, NMV P141964 (*ex* NMV P13769), tangential–oblique section; C, NMV P141906 (*ex* NMV P13763), tangential section; D, NMV P141907 (*ex* NMV P13763), vertical section. E, F, *Syringostromella zintchenkovi* (Khalfina, 1961), × 10, Lilydale Limestone, Mitchell's (Cave Hill) Quarry; E, NMV P141931 (*ex* NMV P13790), vertical section; F, NMV P141930 (*ex* NMV P13790), tangential section.

thickness; one specimen (NMV P141784–85) is intergrown with a specimen of *Pseudotrupetostroma ripperae*. In vertical section the coenosteles are prominent, thick and vertically continuous in the more broadly laminate parts of the skeleton (apparently shorter where the growth banding is more closely spaced); coenosteles are from 0.15 to 0.20 mm across and spaced from 6 to 7 in 2 mm. Coenostroms are represented mainly as local horizontal to oblique offsets from coenosteles, although at bases and tops of latilaminae they may be more continuous; they have a thickness equal to or less than that of the coenosteles. Coenotubes may be represented as vertically aligned, open labyrinthine spaces or may be locally closed where successive coenostrom offsets are developed; these latter are rounded to oval, from 0.13 to 0.2 mm across; in a few other areas, particularly towards the bases or tops of latilaminae where the coenosteles are less continuous, the gallery spaces may be transversely elongate. Astrorhizae occur in a few places in clusters of upwardly and inwardly tapering, tabulated canals, from 0.15 to 0.25 mm across. Scattered dissepiments occur at some levels in gallery spaces and may in rare instances form more continuous though poorly developed microlaminae.

Coenosteles form a distinctive vermiform to meandriform amalgamate network in tangential section, although throughout most of the skeleton there are also associated smaller closed subcircular to irregular coenotubes. The coenosteles are mainly from 0.1 to 0.2 mm across, and the coenotubes are of similar dimensions (0.15 to 0.18 mm). The coenosteles have a microstructure composed of 2 to 3 rows of cellules, and in better preserved areas of the skeleton the walls of the cellules appear to exhibit darker 'melanospheric' dots, possibly representing micropillars (but this cannot be confirmed in available vertical sections). The rounded cellules are of variable size, from 0.03 to 0.07 mm across. Up to four (or five) 'melanospheric' dots seem to occur around the periphery of individual cellules, and they are approximately 0.02–0.03 mm in diameter. Large radiating and branching astrorhizal structures are exhibited, with centres about 3 to 4 mm across and spaced 15 mm apart; they exhibit long, sinuous canals from 0.18 to 0.3 mm wide.

Remarks. This species from Buchan has a finer texture and better preserved microstructures than in the Lilydale occurrences of *S. zintchenkovi*. The material is only provisionally assigned to *Syringostromella labyrinthea*, originally described from allochthonous limestones in the Lower Devonian of Arctic Canada, for the following reasons. First, though the spacing and thickness of coenosteles is very similar, they are apparently less vertically persistent (though this may be due to local variation related to the orientation of vertical sections) and, secondly, the coenostroms are seemingly at least locally more laterally extensive. Thirdly, the astrorhizae are more conspicuous, with upwardly-directed, tabulated astrorhizal canals in vertical sections of the Buchan specimens. Fourthly, latilaminae are clearly defined in the Buchan material but not recorded from the Canadian types. Fifthly, the Buchan material is better preserved; it exhibits details of the cellular (original?) microstructure not seen in the Canadian types.

Family Syringostromatidae Lecompte, 1951

Parallelopora Bargatzky, 1881

Type species. Parallelopora ostiolata Bargatzky, 1881.

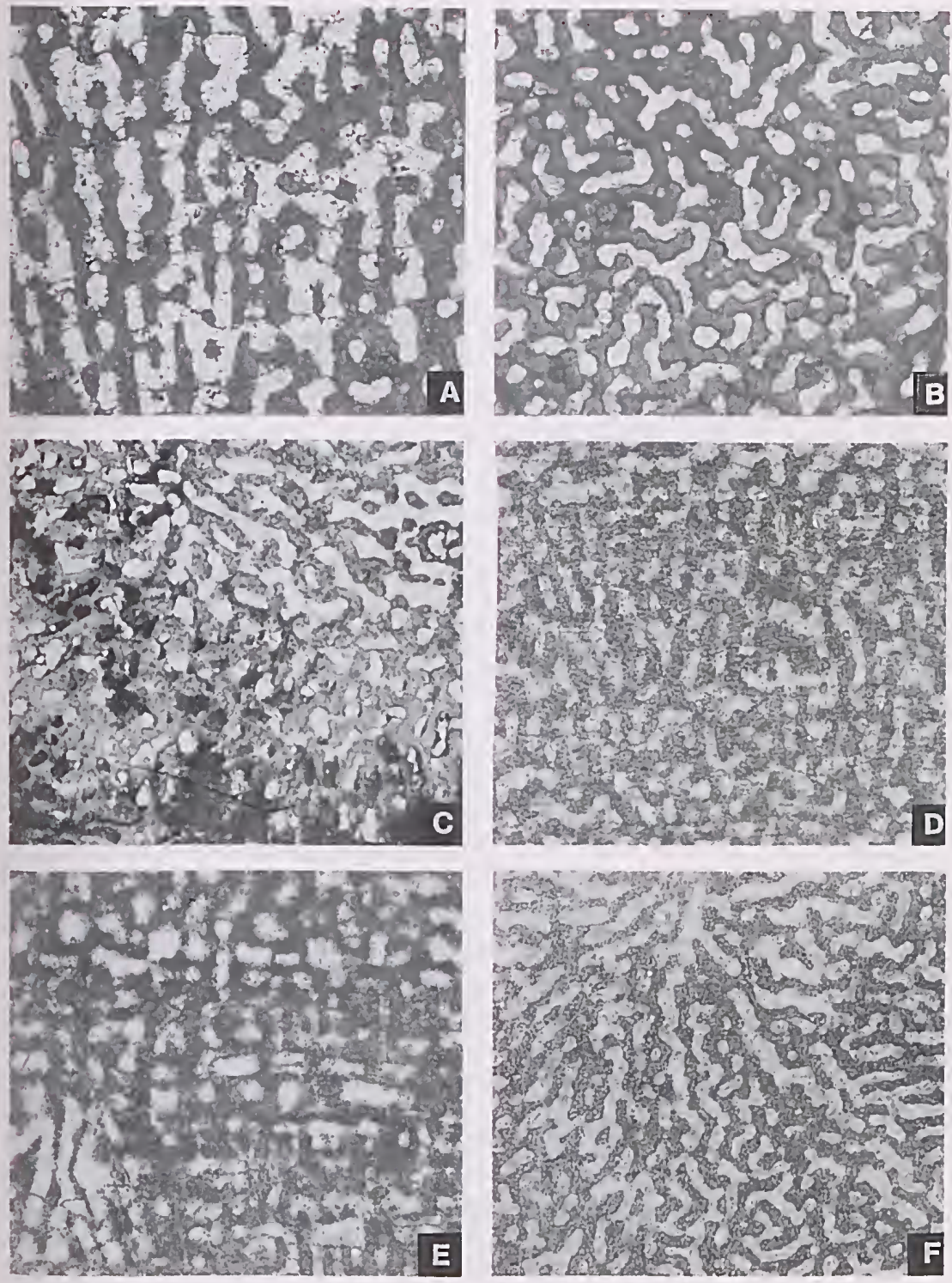
Remarks. Stearn (1993) noted that *Parallelopora* is distinguished by its coenosteles having a coarsely microreticulate microstructure and, in tangential section, mostly joining to form autotubes. The genus has hitherto been regarded by Stearn as restricted to the Middle Devonian, but the species described below extends the range down into the Emsian.

Parallelopora ampla sp. nov.

Figs 22D–F, 31F, 32A–B

Material. Holotype (NMV P136313–15, *ex* NMV P136217), two paratypes (NMV P136316–17, *ex* NMV P136218; NMV P136318019, *ex* NMV

Fig. 25. A–C, *Syringostromella zintchenkovi* (Khalfina, 1961), × 10, Lilydale Limestone, Mitchell's (Cave Hill) Quarry; A, NMV P142003 (*ex* NMV P13790), vertical section; B, NMV P141981 (*ex* NMV P13780), tangential section; C, NMV P141954 (*ex* NMV P13765), vertical–oblique section. D–F, *Syringostromella* cf. *labyrinthea* Stearn, 1990, × 10, Buchan Caves Limestone, Heath's Quarry; D, NMV P141786 (*ex* MUGD 1615), vertical section; E, NMV P141785 (*ex* MUGD 1615), vertical section; F, NMV P141784 (*ex* MUGD 1615), tangential section.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P136219), and three other specimens (NMV P136320–21, *ex* NMV P136220; NMV P136322–23, *ex* NMV P136221; and NMV P136324–35, *ex* NMV P136222), all from the Murrindal Limestone at the Rocky Camp Quarry, Buchan area.

Derivation of name. Latin *amplus*, large, alluding to the coarsely microreticulate skeletal material.

Diagnosis. Species of *Parallelopora* with long, erect coenosteles, 7 to 8 in 2 mm, each composed of 1 to 2 stacked rows of coarse cellules, individually 0.05–0.1 mm in diameter; coenostroms suppressed in favour of rows of closely spaced, aligned dissepiments simulating microlaminae; autotubes and less common coenotubes occur; astrorhizae well developed; latilaminae not confirmed; no mamelons.

Description. Skeleton domical; specimens with a maximum height of 270 mm and diameter of 750 mm. In vertical section the low domal skeleton has strongly developed vertical coenosteles from 0.1 to 0.15 mm in diameter, and spaced from 7 to 8 in 2 mm, with abundant horizontal to gently arched, closely spaced dissepiments crossing intercoenostele spaces, from 0.1 to 0.3 mm apart; in places these may be aligned to form microlaminae. The coenostroms are comparatively less prominent, rarely linking more than two or three coenosteles at a particular level. The most distinctive feature of this species is its coarsely cellular skeletal material, with most individual coenosteles being composed of only one or two rows of stacked large cellules, which may range in size from 0.05 to 0.1 mm across. A few slightly thickened bands are developed in parts of the skeleton but no well defined latilaminae.

In tangential section the coenosteles form a mainly closed, irregular network enclosing autotubes from 0.08 to 0.15 mm across, but locally the intercoenostele spaces are coenotubes of vermiform cross section. The coarse cellules tend to form in single or double rows within the coenostele network. Galleries occupy similar amounts of space to the skeletal elements, and astrorhizae form prominent clusters more than 3 mm across, spaced from 9 to 11 mm apart. The branching and radiating astrorhizal canals are from 0.15 to 0.25 mm wide.

Remarks. This species resembles the type species in the diameter and spacing of the coenosteles and in the pattern of aligned, closely spaced dissepiments forming microlaminae (Lecompte 1952, Galloway & St Jean 1957). However, the type species has better-defined latilaminae and the coenosteles show finer, more regularly aligned rows of cellules, commonly two to four rows to each coenostele, the individual cellules being 0.025 mm in diameter, as compared to *P. ampla* which has only one or two rows to each coenostele, the cellules being 0.05 to 0.1 mm in diameter.

Genus **Coenostroma** Winchell, 1867

Type species. Stromatopora monticulifera Winchell, 1866.

Coenostroma sp.

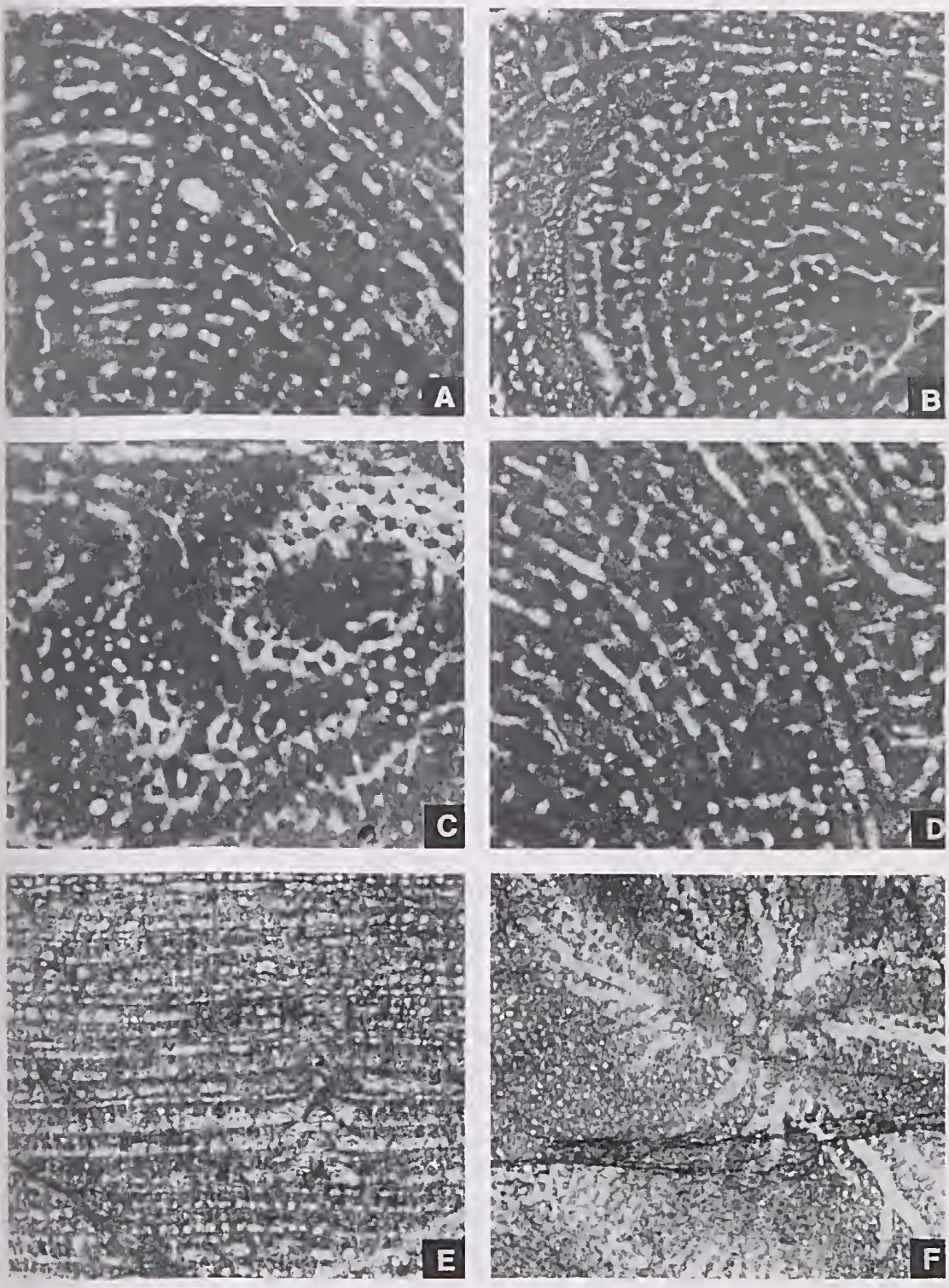
Fig. 26A–D

Stromatopora concentrica var. *colliculata*.—Ripper 1937c: 26, pl. 5, figs 3–4.—Ripper 1938: 236.

Material. Eight specimens from the Buchan Caves Limestone, Heath's Quarry, near Buchan: NMV P136334–35 (*ex* NMV P136181), NMV P136336–37 (*ex* NMV P136182), NMV P136338–39 (*ex* NMV P136183), NMV P136340–41 (*ex* NMV P136184), NMV P141751, NMV P141773–74, NMV P141778–79, NMV P141796–97. Ripper (1937c) previously figured NMV P141773 as pl. 5, fig. 3, and NMV P141774 as pl. 5, fig. 4).

Description. Surface is broadly mammillate with some astrorhizae. In vertical section thick coenostroms predominate and in most places form an amalgamate grid with the equally thick but less prominent and less extensive coenosteles; these latter are locally continuous across up to ten coenostroms. The coenostroms are of uneven thickness, commonly from 0.1 to 0.25 mm, and spaced from 6 to 8 in 2 mm; details of skeletal microstructure are limited by the poor preservation, but a few traces of thin, lighter and darker layers suggest microlaminae. Galleries tend to be rounded to slightly laterally elongate, from 0.1 to 0.2 mm across. In a few places, the normal, coarse, grid-like mesh is interrupted by a distinctive latilaminar discontinuity surface with a dense, 0.1 mm thick basal layer and

Fig. 26. A–D, *Coenostroma* sp., × 10, Buchan Caves Limestone, Heath's Quarry; A, NMV P141751, vertical section; B, NMV P141797, tangential section; C, NMV P141774, tangential section; D, NMV P141773, vertical section. E, F, *Habrostroma tyersense* sp. nov., × 10, Coopers Creek Limestone, Tyers Quarry; E, holotype NMV P136342 (*ex* NMV P136185), vertical section; F, holotype NMV P136343 (*ex* NMV P136185), tangential section.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succeeding 0.5 mm thick unit of much finer amalgamate skeletal material.

In tangential section coenosteles form a vermicular to irregularly complete network, but there are also local areas of discrete pillars with rounded to irregular cross sections; these are from 0.1 to 0.3 mm (on average 0.2 mm) in diameter. Darker, concentric bands of skeletal material are coenostroms with a few rounded pores, from 0.1 to 0.2 mm across. Dissepiments are present in larger gallery spaces, commonly associated with discrete pillars, and may cross three or more successive interlaminar spaces in partitioning vertical astrorhizal canals or vertically elongated gallery spaces (?coenotubes). Astrorhizae comparatively small and scattered though the skeleton, with rare vertical canals up to 0.5 mm in diameter, and more common, branching, growth-parallel tubes from 0.15 to 0.3 mm wide.

Remarks. This species is based on a number of rather poorly preserved specimens. Despite additional collecting and preparation of new material, details of the finer structure and microstructure could not be further clarified. The species is therefore best left in open nomenclature.

These specimens resemble *Stromatopora teretiuscula* Yang & Dong, 1979 from the Fulong Member of the Donggangling Formation (Middle Devonian) of Ertang, Wu Xuan County, north-central Guangxi, south China. That species has similar dimensions and spacing of coenostroms and coenosteles (pillars), but these elements are less thickened, resulting in more prominent coenotubes. Also the astrorhizae are finer and less conspicuous.

Genus Habrostroma Fagerstrom, 1982

Type species. Stromatopora proxilaminata Fagerstrom, 1961.

Habrostroma tyersense sp. nov.

Figs 26E–F, 27A–E, 32D–E

Stromatopora foveolata.—Ripper 1937b: 185, text fig. 2A, B.—Ripper 1938: 236.

non *Stromatopora* aff. *foveolata.*—Ripper 1937c: 22, pl. 4, figs 5, 6.

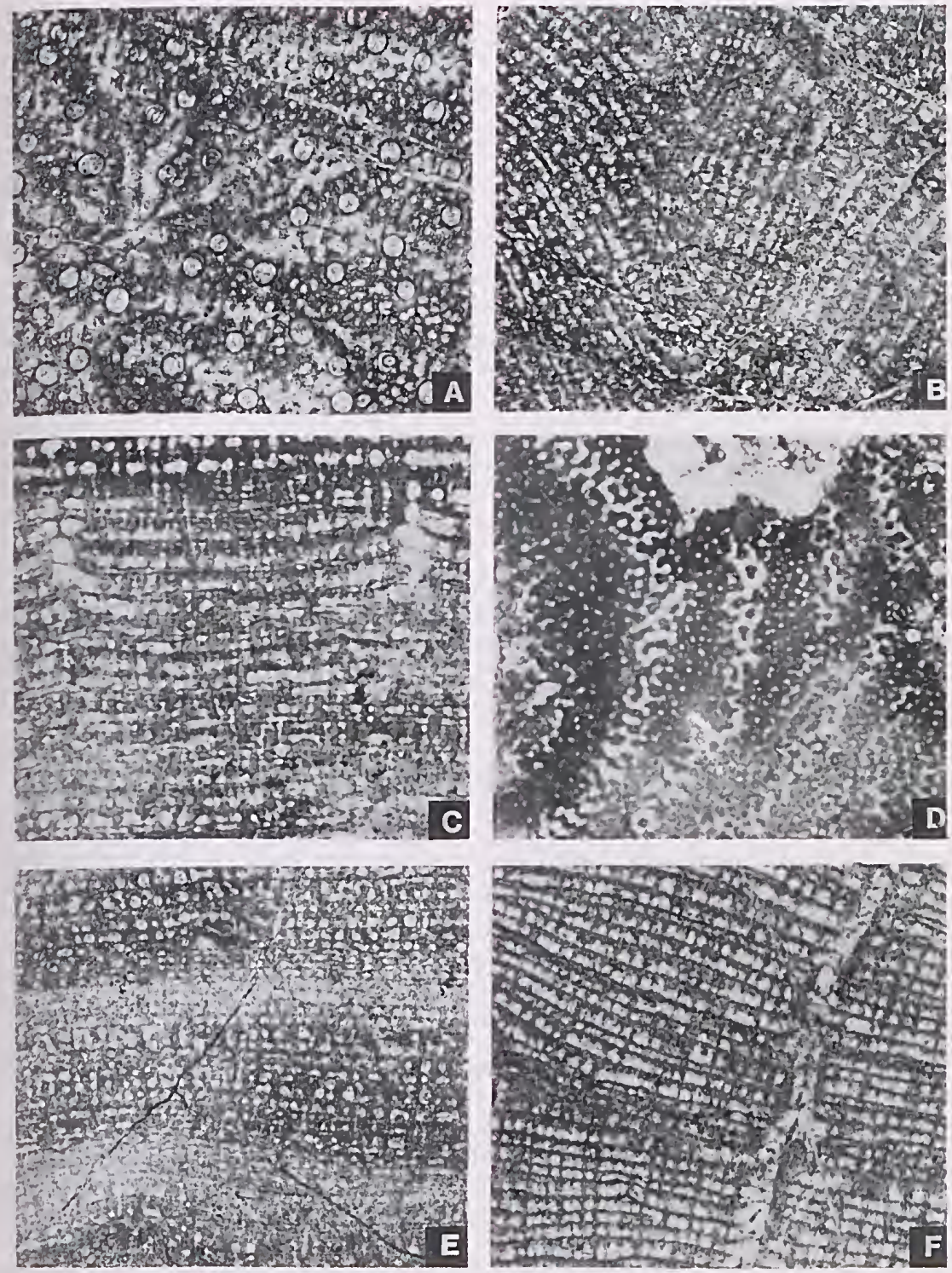
Material. Holotype (NMV P136342–43, *ex* NMV P136185) and three paratypes (NMV P136344–45, *ex* NMV P136186; NMV P136346–47, *ex* NMV P136187; NMV P136348–50, *ex* NMV P136188) from the Coopers Creek Limestone, Tyers Quarry near Tyers. Three poorly preserved specimens (NMV P136351–53, *ex* NMV P136189; NMV P136354–55, *ex* NMV P136190; NMV P136356–57, *ex* NMV P136191) from the same horizon and locality are also included, as well as two other well preserved specimens (NMV P136358–59, *ex* NMV P136192; NMV P136360–61, *ex* NMV P136193) which have associated eaunopore tubes and a minor morphological difference, namely, thinner coenostroms with fewer microlaminae, commonly the uppermost only being conspicuous (these latter forms possibly represent a separate variant). Three additional specimens, NMV P136402 (*ex* NMV P13771), NMV P141887–88, NMV P141909–10 and NMV P141949–50 (*ex* NMV P13764), from the Lilydale Limestone at Mitchell's (Cave Hill) Quarry, Lilydale, are also regarded as conspecific.

Two altered and sheared specimens, NMV P136362–63 (*ex* NMV P136195) and NMV P136364–65 (*ex* NMV P136196), from the limestone megaclast at Evans Quarry near Coopers Creek, are only doubtfully included. Another specimen (NMV P136366–67, *ex* NMV P136197) from the Waratah Limestone at the old limekilns site at Walkerville South is also only tentatively assigned since it exhibits a skeletal mesh close to the coarser end of the range of variability of the species. The Waratah specimen is associated with the symbiotic organism *Helicosalpinx* Oekentorp, 1969.

Derivation of name. After the type locality, Tyers Quarry.

Diagnosis. A species of *Habrostroma* with continuous, alternating couplets of porous coenostroms and intercoenostrom spaces (including coenosteles and galleries); couplets of variable thickness though retaining ratio of coenostrom thickness equal to, or less than, intervening gallery height; each coenostrom composed of one or more microlaminae (up to 4) and associated rows of microreticulate skeletal material; coenostroms spaced from 8 to 10 in 2 mm; astrorhizae well developed, with centres spaced 6–9 mm apart; microstructure cellular and microreticulate.

Fig. 27. A–E, *Habrostroma tyersense* sp. nov., × 10; A, NMV P136361 (*ex* NMV P136193), tangential section; B, paratype NMV P136349 (*ex* NMV P136188), vertical section; C, NMV P141887, vertical section; D, NMV P141888, tangential section; E, paratype NMV P136347 (*ex* NMV P136187), vertical section; A, B, E, Coopers Creek Limestone, Tyers Quarry; C, D, Lilydale Limestone, Mitchell's (Cave Hill) Quarry, Lilydale. F, *Atopostroma distans* (Ripper, 1937e), NMV P141782, vertical section, × 10, Buchan Caves Limestone, Heath's Quarry.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Description. The skeleton is laminar and the surface may be smooth or broadly mammillate with gently arched crests and moderately sharply folded troughs; and latilaminate, not with discontinuities but with alternating phases of thickened, closely spaced and more widely spaced coenostroms, in some specimens from 2 to 3 mm apart.

Coenostroms are continuous and of varying thickness, from 0.05 to 0.12 mm thick; spaced from 7 to 12 (most commonly 8 to 10) in 2 mm. Typically one or two, but in a few places up to four, microlaminae are present, with rows of small cellules intervening between the microlaminae; individual microlaminae are about 0.02 mm thick. Traced laterally one coenostrom with four microlaminae divides into two coenostroms each with paired microlaminae.

Coenosteles typically confined between coenostroms but in some places superposed through up to six intercoenostromal spaces; they are upward-flaring between coenostroms, and from 0.9 to 0.15 mm (rarely to 0.2 mm) in diameter; they are spaced from 9 to 11 in 2 mm. Gallery spaces are commonly dome-like, rarely oval, and a few have associated dissepiments; galleries may occupy one-half to three-quarters of the intercoenostromal spaces (the rest is coenostromal skeletal material). Astrorhizae include growth-parallel canals up to 0.2 mm, with a few tabulae which join vertical clusters of canals that may contain superposed tabulae.

In tangential sections vertical elements range from rounded to irregular (pillars), to vermicular (coenosteles). Obliquely intersected coenostroms show very abundant, rounded to irregular and rarely dumbbell-shaped pores, from 0.05 to 0.12 mm in diameter and spaced about 22 to 25 in 1 mm^2; the rounded pores under magnification show darker, wall-like rims of skeletal material about 0.01 mm thick. Astrorhizae prominent, forming outwardly radiating and branching, wall-less canals from centres spaced about 6.5 to 9 mm apart; each centre has up to six radiating canals extending from a 1 mm wide, ring-like cluster of vertical tubes; the growth-parallel canals may be impressed into the undersurface of the succeeding coenostrom; in a few places the canals abut against the denser, adjacent coenostromal skeletal material. Microstructure is cellular and microreticulate, with somewhat irregularly-shaped cellules from 0.03 to 0.05 mm across, and also in a few places darker specks occur around the periphery of the cellules (up to five giving a polygonal appearance); these may represent micropillars, from 0.01 to 0.02 mm across.

Remarks. The Lilydale specimens, formerly assigned by Ripper (1937b) to *Stromatopora foveolata* (Girty, 1895), are closely similar to the Tyers material but not as well preserved; the specimens also have very slightly thicker coenosteles (nearer to 0.2 mm in diameter) than typical representatives from Tyers but still presumably within limits of intraspecific variability of the species.

Ripper (1937b) allied a specimen from the Murrindal Limestone in the Rocky Camp Quarry of the Buchan district to the form she described as *Stromatopora foveolata* from Lilydale. She noted that it exhibits a somewhat coarser and more thickened skeletal mesh. This Rocky Camp specimen (NMV P141725–27, *ex* MUGD 1609) probably belongs to a second, stratigraphically slightly younger species of *Habrostroma*.

This well preserved species has the cellular and microreticulate microstructure of *Habrostroma* (akosmoreticular microstructure of Stock 1989), as shown in Fig. 31E, and it also seems clearly distinct from other described species of the genus. It most closely resembles *Habrostroma astrorhizoides* (Birkhead, 1967) from the lower part of the Cedar City Formation (Eifelian) in Missouri (Birkhead 1986), with similar spacing of vertical structural elements, cellular microstructure and astrorhizae, but it has a less regular alternation of coenostroms and open gallery spaces throughout the skeleton.

Habrostroma centrotum (Girty, 1895) from the Manlius Formation (Lochkovian) of New York, recently revised by Stock (1991), may also be compared, even though it is interpreted by Stearn (1993) as a representative of *Parallelostroma*. It has similar skeletal elements and proportions, with its regular and continuous coenostroms separated by gallery spaces. The gallery height is commonly equal to or greater than the thickness of the overlying coenostroms, as in *H. tyersense*. However, most specimens of *H. centrotum*, like the other Lochkovian species assigned to *Habrostroma* by Stock (1988, 1991), exhibit additional, localized, dissepiment-like microlaminae not seen in *H. tyersense*.

A species referred informally to *Habrostroma* from the Jesse Limestone (Emsian) of central New South Wales (Webby & Zhen 1993) shows little close resemblance to *H. tyersense* except in developing similar microreticulate skeletal material in the coenosteles.

Genus Atopostroma Yang & Dong, 1979

Type species. Atopostroma tuntouense Yang & Dong, 1979.

Remarks. Stearn (1983) and Webby & Zhen (1993) have summarised views on the interpretation of this genus.

Atopostroma distans (Ripper, 1937c)

Figs 27F, 28A—D

Actinostroma stellulatum var. *distans* Ripper 1937c: 12, pl. 2, figs 1–2.—Ripper 1938: 236.—Teichert & Talent 1958: 16.

Actinostroma cf. *distans*.—Flügel 1958b: 180.

Actinostroma (Actinostroma) distans.—Flügel 1959: 142.

Actinostroma stellulatum distans.—Flügel & Flügel-Kahler 1968: 403.

Trupetostroma cf. *ideale*.—Stearn & Mehotra 1970: 16, pl. 5, figs 1–2.

Atopostroma tuntouense.—Stearn 1983: 548, fig. 4E–H.

non *Atopostroma tuntouense*.–Stearn 1990: 496, figs 4.1, 4.2, 8.2.

Atopostroma distans.—Webby & Zhen 1993: 346, figs 11A–D, 12E.

Material. Holotype NMV P141754–57 (*ex* MUGD 1610) and eleven other specimens, NMV P136368–69 (*ex* NMV P136198), NMV P136370–71 (*ex* NMV P136199), NMV P136372–73 (*ex* NMV P136200), NMV P136374–75 (*ex* NMV P136201), NMV P136376–77 (*ex* NMV P136202), NMV P136378–79 (*ex* NMV P136203), NMV P136380 (*ex* NMV P136204), NMV P141767–68, NMV P141763–64, NMV P141782–83, NMV P141800–01), all from the Buchan Caves Limestone at Heath's Quarry.

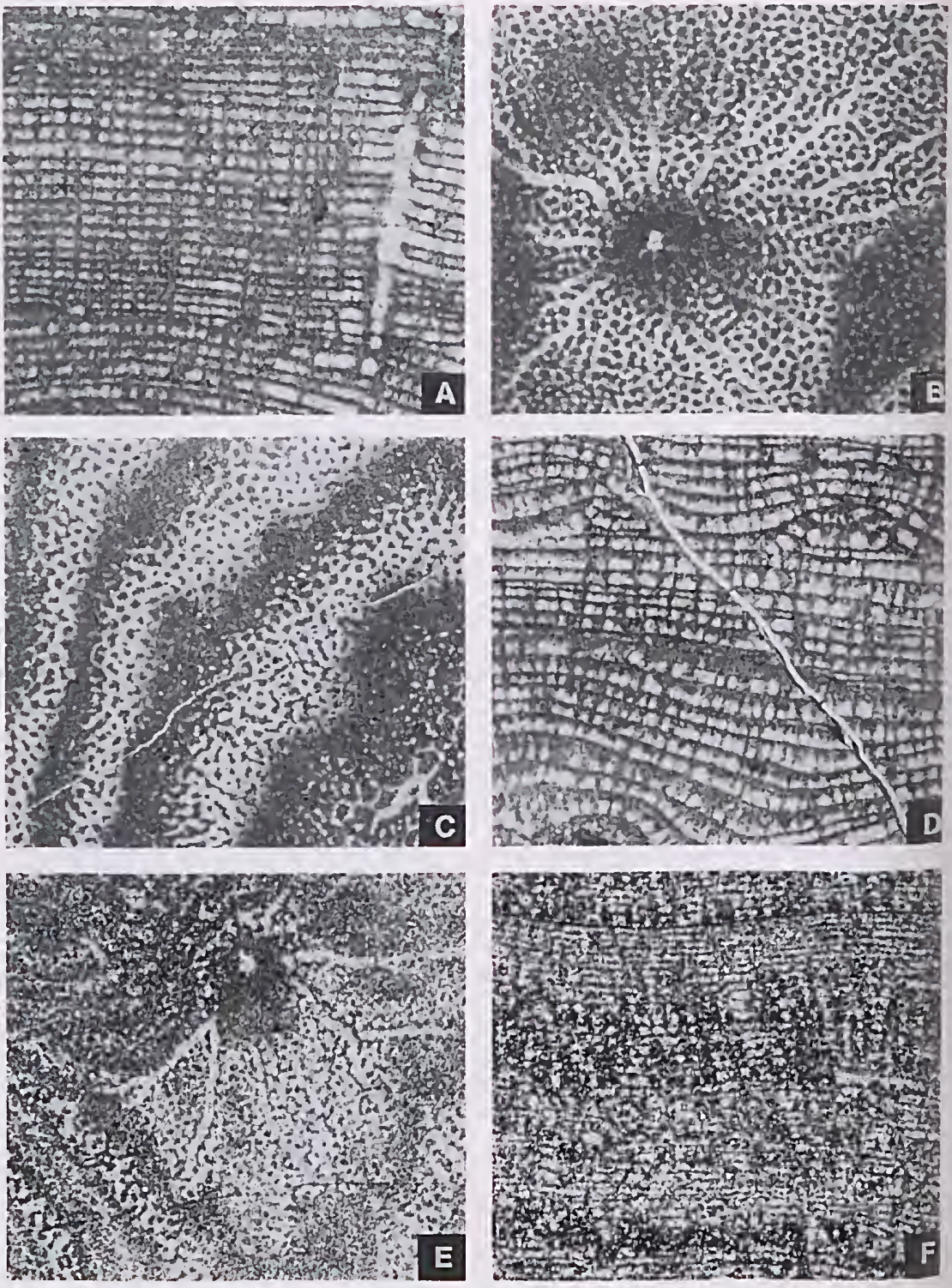
Description. This latilaminate species shows the characteristic pattern of superposed pillars and laterally continuous, regular laminae. The pillars typically thicken upwards into overlying laminae and are from 0.10 to 0.15 mm thick; spaced from 8 to 9 in 2 mm. The laminae are of variable thickness, ranging from 0.07 to 0.15 mm in thickness; spaced from 7 to 12 in 2 mm; latilaminae may be defined by patterns of change in spacing and thickness of laminae and by interruptions of growth; they range from 2 to 14 mm in thickness; fork-like splays of individual laminae may occur with up to three microlaminae developed. Dissepiments are rare.

Astrorhizae are well developed and conspicuous, locally centred on crests but also commonly offset to the sides; composed of a regular series of single vertical columns spaced from 5 to 12 mm apart through the skeleton (individually traceable for up to 4 mm vertically), and each connecting into many (up to 13 counted) radiating and branching canals occupying interlaminar spaces; in the horizontal plane these individual stellate clusters may be up to 9 mm across; the columns are vertically traceable for up to 4 mm and are usually about 0.3 mm in diameter, and canals are wall-less and from 0.1 to 0.2 mm wide.

The shapes of pillars cut in tangential sections change markedly from the base to the top of an interlaminar space, from rounded to irregular outlines in the lower part, through elongate to curved and sinuous, to meandriform in the upper part, a part of an irregular network which merges into overlying laminae. Well preserved, obliquely intersected laminae show a random pattern of rounded pores, from 0.07 to 0.1 mm across, and much finer, rounded structures interpreted as cellules, about 0.01–0.03 mm across; this porous tissue is more clearly shown in the lower part of the lamina than in the denser upper part; at the top of the lamina there is an abrupt change into the overlying 'open' gallery, with again the widely spaced, rounded to irregular pillars.

Remarks. This species is recognized from the Buchan Caves Limestone at Heath's Quarry and from the Jesse Limestone (Emsian) of the Limekilns area, central New South Wales (Webby & Zhen 1993). Details of the listed synonymy have been discussed previously by Webby & Zhen (1993). *A. distans* differs from the type species, *A. tuntouense* from the Yujiang Formation (early Emsian) of Guangxi, south China, in having thicker laminae, thinner pillars with narrower spacing, and more prominent astrorhizae. The type species is recorded by Yang & Dong (1979) as having thin and compact laminae, 0.02–0.03 mm thick and spaced 6–7 in 2 mm (locally up to 9–10 in 2 mm); thick pillars, slightly widening upwards and superposed, 0.15–0.18 mm in diameter and spaced 6–8 in 2 mm; pillars appearing as irregular dots in tangential section, with 3–5 radial processes, merging into sharp pointed networks adjacent to laminae; diameter of cellules 0.01 mm and of vacuoles (pores) 0.02 mm; weakly developed astrorhizae, with canals 0.17–0.19 mm wide.

A. distans also occurs in the Blue Fiord Formation (early Emsian) of Arctic Canada. Stearn (1983) previously assigned the Blue Fiord specimens to the type species but they more closely resemble *A. distans* in respect to the thickened laminae, microlaminae and astrorhizae. Other material also included in *A. tuntouense* by Stearn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(1990), from allochthonous Early Devonian clasts in the Stuart Bay Formation of Arctic Canada, is markedly different, having much closer spacing of laminae (16 in 2 mm as compared with 7 to 12 in 2 mm of *A. distans*), and should probably be excluded from both named taxa.

Atopostroma flexuosum (Yavorsky, 1955) from the Eifelian of the Kuznetsk Basin, Russia, differs from *A. distans* in having thinner and more widely spaced laminae, and less conspicuously superposed and variably spaced, gently curved pillars.

Three additional specimens (NMV P136381–82, *ex* NMV P136207; NMV P136383–84, *ex* NMV P136208; NMV P136385–86, *ex* NMV P136209) from the Buchan Caves Limestone at Heath's Quarry are doubtfully included in the species because they are poorly preserved and show a more thickened (possibly secondarily altered), regular grid-like mesh of laminae and pillars, somewhat similar to the structure of *Gerronostroma*, and the laminae are slightly more closely spaced, from 9 to 14 in 2 mm.

Atopostroma sp.

Fig. 28E–F

Material. One specimen (NMV P136387–88, *ex* NMV P136210) from the Murrindal Limestone at Rocky Camp Quarry, Buchan area.

Comparative description. This finer species of *Atopostroma* is represented by only one specimen. It is conspicuously latilaminate (the latilaminae from 2 mm to more than 7 mm apart) and weakly mammillate (with domes spaced about 11 to 15 mm apart); it has regular, thin, laterally continuous laminae, and comparatively thickened and in many places superposed pillars. The laminae are closely spaced from 15 to 17 in 2 mm, and are 0.02 to 0.03 mm (sometimes to 0.05 mm) thick. The pillars are from 0.05 to 0.10 mm (commonly 0.07–0.08 mm) in diameter, and 0.10 to 0.15 mm apart (from 9 to 12 in 2 mm). Astrorhizae are very conspicuous in tangential section, with radiating clusters from 7 to 11 mm apart, and individual stellate, branching canals from 0.12 to 0.25 mm across; these clusters are not always associated with mamelons.

Although this Murrindal species has the same spacing of laminae and pillars as in Stearn's (1990) Stuart Bay *Atopostroma* (doubtfully either *tuntouense* or *distans*), it differs markedly in other features, such as the thickness of pillars (0.07–0.08 mm in diameter in the Murrindal species, 0.15 mm in the Stuart Bay species) and astrorhizae (large and well developed in the Murrindal species, small and inconspicuous in the Stuart Bay species).

Genus Columnostroma Bogoyavlenskaya, 1972a

Type species. Coenostroma ristigouchensis Spencer, 1884.

Remarks. In terms of generic relationships, Stearn (1966) first commented that, based on its gross structure, *Syringostroma ristigouchense* (Spencer, 1884) was better placed in *Parallelopora*. However, Fagerstrom (1982, pl. 3, figs 7–8) retained the species in *Syringostroma*, although Bogoyavlenskaya (1972a) established the new genus *Columnostroma* based on *S. ristigouchense* as type species. *Columnostroma* is characterized by the presence of long, continuous, clinoreticulate and rounded pillars, thick coenostroms only locally persistent and interrupted by pores, and coenotubes with dissepiments (Stearn 1993).

Columnostroma clathratum sp. nov.

Figs 29A–F, 32F

Syringostroma aff. *niagarense*.—Ripper 1937b: 179, text-fig. 1.—Ripper, 1938: 236.

Material. Holotype, NMV P141922–23, P141990–91 (*ex* NMV P13784) and three paratypes, NMV P141932–33, P142007–08 (*ex* NMV P13791), NMV P141875–76, and NMV P37638, all from the Lilydale Limestone at Mitchell's (Caves Hill) Quarry, Lilydale.

Derivation of name. Latin *clathratus*, meaning latticed or screened.

Diagnosis. A species of *Columnostroma* with long, stout, microreticulate pillars forming an incipient network with thin, closely spaced,

Fig. 28. A–D, *Atopostroma distans* (Ripper, 1937c), × 10, Buchan Caves Limestone, Heath's Quarry; A, holotype NMV P141755 (*ex* MUGD 1610), vertical section; B, holotype NMV P141757 (*ex* MUGD 1610), tangential section; C, NMV P141783, tangential section; D, NMV P141782, vertical section. E, F, *Atopostroma* sp., × 10, Murrindal Limestone, Rocky Camp Quarry; E, NMV P136388 (*ex* NMV P136210), tangential section; F, NMV P136387 (*ex* NMV P136210), vertical section.

porous laminae or horizontal dissepiments (16–22 in 2 mm); latilaminae at least 10 mm thick, and scattered astrorhizae.

Description. Only a few discontinuity surfaces occur, and latilaminae are widely spaced, at least 10 mm thick; overall skeleton is laminar to weakly mammillate. Vertical sections composed of a grid with dominance of stout, long, spool-shaped, superposed pillars and less prominent, thin, closely spaced laminae. The pillars extend continuously through at least 8 mm vertically and do not branch; they are spaced from 8 to 9 in 2 mm and each is about 0.2 mm in diameter. Only in a few places are traces of a cellular, possibly a clinoreticulate, microstructure shown in the pillars.

Because of the comparatively poor preservation it is difficult to interpret the nature of laminae between the pillars; in the interspaces between the pillars they are most commonly thin, horizontal plates, apparently continuous, about 0.02 to 0.03 mm thick, and resembling microlaminae (or horizontal dissepiments), but in some other places they are thicker, though not laterally extensive layers, up to 0.1 mm thick. The spacing of laminae is from 16 to 22 in 2 mm. The interspaces between the pillars appear in a few areas of the skeleton more like coenotubes crossed by horizontal dissepiments but in most other areas like gallery spaces bounded by thicker laminae. Astrorhizal canals occupy transversely elongated gallery spaces, and are from 0.1 to 0.15 mm wide; they bend upwards to join one or more of the ring-like clusters of vertical canals (each 0.15 mm across) in various parts of the skeleton in tangential section.

Pillars have rounded to irregular outlines in tangential sections but tend to be more vermicular near intersections with laminae; they range from 0.15 to 0.2 mm in diameter and show a microstructure of cellules about 0.02 to 0.03 mm across. The laminae have abundant rounded pores from 0.08 to 0.15 mm (on average 0.1 mm) in diameter; from 14 to 20 in each 1 mm^2. Astrorhizae comprise branching and radiating, growth-parallel, wall-less canals from 0.12 to 0.2 mm in diameter; a few ring-like clusters of 2 to 5 vertical tubes, each from 0.15 to 0.2 mm in diameter.

Remarks. Compared with the type species, *C. ristigouchensis* from the Lower Devonian of New Brunswick, Canada (see Fagerstrom 1982, pl. 3, figs 7, 8), *C. clathratum* has a more densely fused skeletal structure, closer spacing of thin laminae, and more continuously linked networks of pillars and laminae with pores in tangential section. Relatively greater areas of the skeleton of the type species, as seen in tangential section, exhibit isolated, rounded pillars joined by radial processes (possibly these latter represent intersections with the blister-like dissepiments seen in vertical section). *C. gallowayi* (Fritz & Waines, 1956), from the Middle Devonian Upper Abitibi River Formation of Ontario, exhibits a closer resemblance to the Victorian species, with pillars of much the same dimensions and spacing, and a similar fused network pattern of pillars and laminae with pores in tangential section. However, *C. gallowayi* has very thin latilaminae (about 0.5 to 0.8 mm thick) and obscure, ill-defined laminae. None of the six other species assigned to the genus (Stearn 1993) is similar to *C. clathratum*.

Order Amphiporida Rukhin, 1938

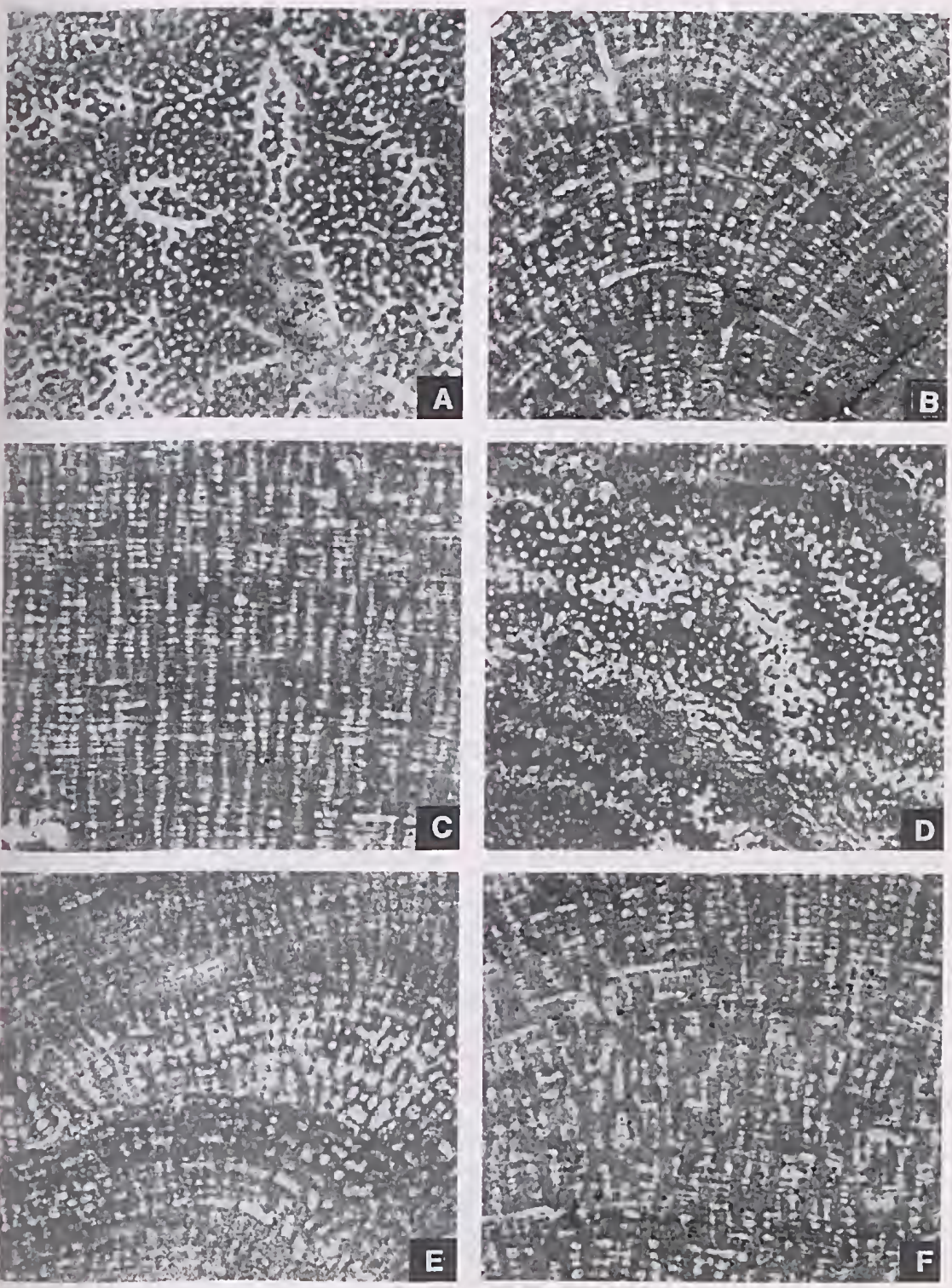
Genus Stellopora Bogoyavlenskaya 1972b

? *Columdictyon* Dong & Wang 1982: 29–31.
? *Tianshanostroma* Dong & Wang 1984: 269.
? *Qinghaipora* Dong 1991: 75.

Type species. Amphipora intexta Yavorsky, 1957.

Remarks. Bogoyavlenskaya (1972b) established *Stellopora* with *A. intexta*, from the Lower Devonian (Lochkovian) of Salair, south-west Siberia, as type species by original designation. Earlier (Bogoyavlenskaya 1970) she attempted to introduce the genus without fixation of type species, a procedure not satisfying the criteria of availability of the International Code of Zoological Nomenclature (Article 13 (b); Ride et al. 1985). In another paper, Bogoyavlenskaya (1971) proposed a different generic name, *Columnoporella*, also with *A. intexta* as type

Fig. 29. Columnostroma clathratum sp. nov., × 10, Lilydale Limestone, Mitchell's (Cave Hill) Quarry, Lilydale; A, holotype NMV P141990 (*ex* NMV P13784), tangential section; B, paratype A NMV P141933 (*ex* NMV P13791), vertical section; C, paratype A NMV P141933 (*ex* NMV P13791), vertical section; D, paratype B NMV P141876, tangential section; E, paratype B NMV P141875, vertical section; F, paratype C NMV P37638, vertical section.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species, but this name is a junior homonym of *Columnoporella* Sokolov & Tesakov, 1963, a syringophyllid coral. The name *Columnoporella* is crossed out and *Stellopora* is substituted in handwriting in printed copies of Bogoyavlenskaya's 1971 paper, but this handwritten name is not validly published within the meaning of Article 9 (1) of the Code. Consequently the name *Stellopora* dates from Bogoyavlenskaya's 1972 paper and not from the earlier publication of 1971 (cf. Bogoyavlenskaya 1973, Khromych 1974, Stearn 1980, Bogoyavlenskaya & Khromych 1985).

Dong & Wang (1982) introduced the genus *Columdictyon* (with type species *C. regulare* from the upper Middle Devonian of Yunnan, south China) to accommodate forms with upwardly and outwardly radiating pillars and associated upwardly arched laminae like *Stellopora*, but differing in lacking a clearly defined axial canal and marginal vesicles. It may be a matter of interpretation but Dong & Wang's (1982) figured type specimens do seem to show a few marginal vesicles and a very fine axial canal, so the justification for the separate genus is questioned. *Tianshanostroma*, based on *T. xinjiangense* Dong & Wang, 1984 from the Middle Devonian of Xinjiang, north-west China, has very similar upwardly and outwardly radiating pillars, upwardly arching laminae, an axial canal is apparently absent, and peripheral vesicles are not clearly developed. Consequently it is closely related to material previously referred to *Columdictyon* and should be tentatively included in *Stellopora*. A third, closely-related Chinese taxon is the basis for another doubtfully independent genus. In the description of *Qinghaipora* (type species *Q. gracilenta*, based on very poorly preserved specimens from the upper Middle to lower Upper Devonian of southern Qinghai), Dong (1991) emphasised skeletal elements dominated by long, closely spaced pillars, vague laminar elements and an axial canal. This material seems also to represent a species of *Stellopora*.

The dendroid and columnar genus *Stellopora* ranges from the Upper Silurian to the Upper Devonian but is most commonly found in Middle Devonian successions, given that 13 of the 21 described species come from this interval. The genus is readily distinguished from *Amphipora* (based on type species *Caunopora ramosa* Phillips, 1841) by having long, radiating pillars extending outwards and upwards from near the axis. *Amphipora* has a similar growth habit and stratigraphic range, but has markedly different internal elements, notably axial and peripheral zones of amalgamate skeletal material without continuous pillars or laminae.

Stellopora porrecta sp. nov.

Fig. 30A–F

Amphipora ramosa.—Philip 1960: 153.—Philip 1962: 130.

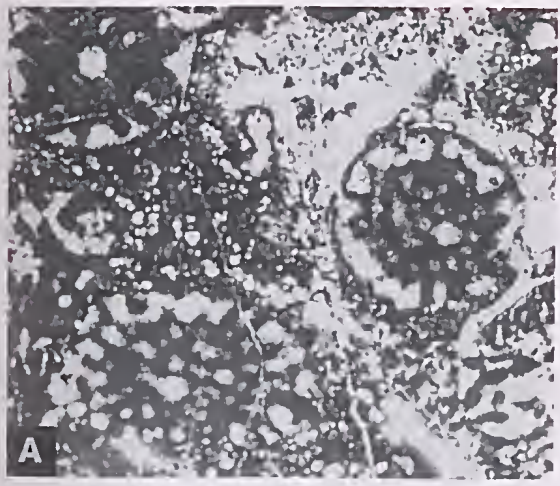
Material. Numerous fragmentary stick-like branches have been cut from two rock samples (NMV P136389–91, *ex* NMV P136211; and NMV P136392–97, *ex* NMV P136212) from the Bell Point Limestone near the mouth of Bluff Creek, Waratah Bay. Holotype is NMV P136393, illustrated in longitudinal section in Fig. 30D. All other illustrated specimens are designated paratypes.

Derivation of name. Latin *porrectus*, alluding to the forwardly and outwardly directed pillars.

Diagnosis. A species of *Stellopora* with branches 1.7–3.5 mm in diameter, a small axial canal 0.25–0.6 mm (on average 0.3–0.4 mm) in diameter, two series of pillars 0.08–0.15 mm thick, and associated lateral processes, and a discontinuous row of marginal vesicles 0.3–0.5 mm wide.

Description. Skeleton consists of slender, stem-like branches up to 30 mm in length and from 1.7 to 3.5 mm (on average 2.6 mm) in diameter. Some branches show relatively unthickened internal structures, but in others much of the internal gallery space, except for areas of axial canals and marginal vesicles, is filled with thickened skeletal elements. The outer wall ranges from 0.06 to 0.1 mm in thickness, and the axial canal is from 0.25 to 0.5 mm (on average 0.3-0.4 mm) in width. Marginal vesicles are much larger than other gallery spaces, from 0.3 to 0.5 mm in width (measured radially from the outer wall inwards). Skeleton shows two series of pillars in cross section, with associated lateral

Fig. 30. Stellopora porrecta sp. nov., × 10, Bell Point Limestone, Bluff Creek, Waratah Bay; A, NMV P136395 (*ex* NMV P136212), transverse section; B, NMV P136392 (*ex* NMV P136212), vertical–oblique and transverse section; C, NMV P136396 (*ex* NMV P136212), oblique–vertical section; D, holotype NMV P136393 (*ex* NMV P136212), vertical section; E, NMV P136393 (*ex* NMV P136212), vertical section; F, NMV P136391 (*ex* NMV P136211), transverse section.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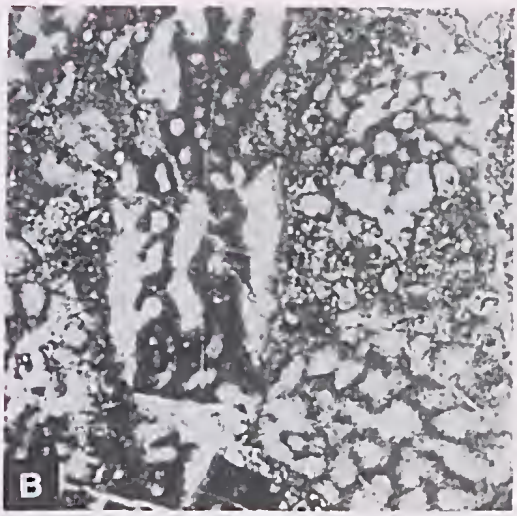
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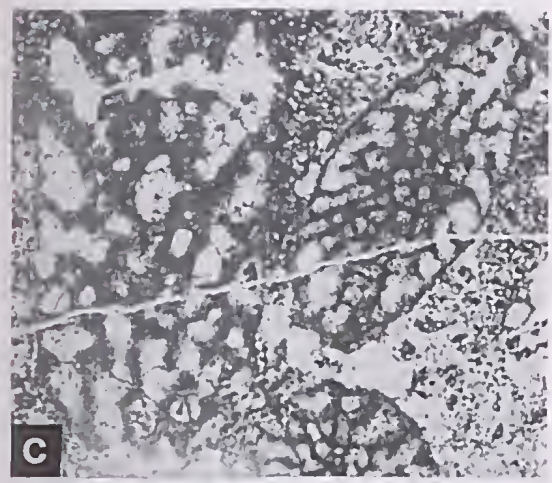
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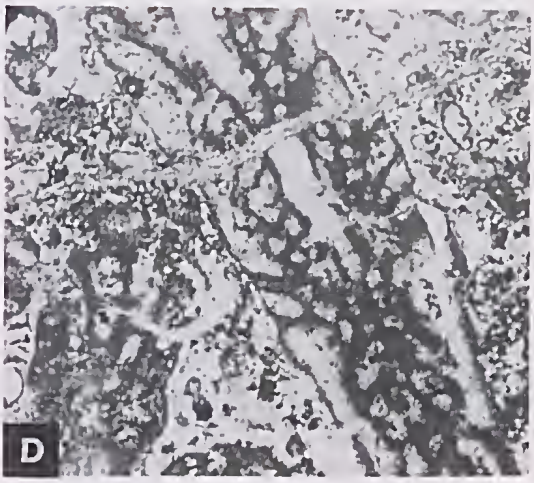
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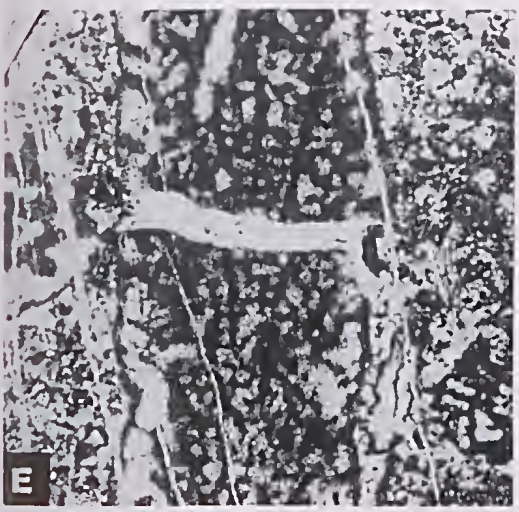
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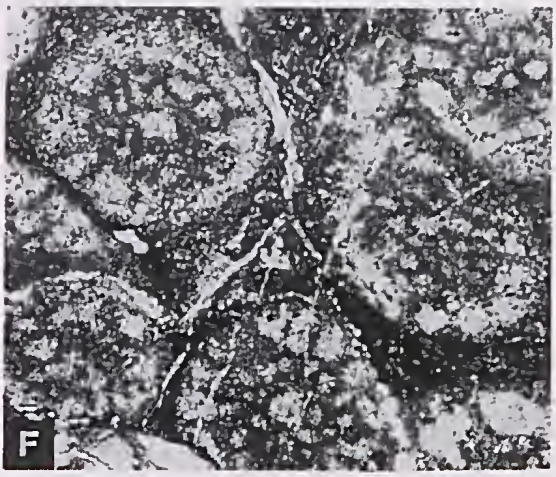
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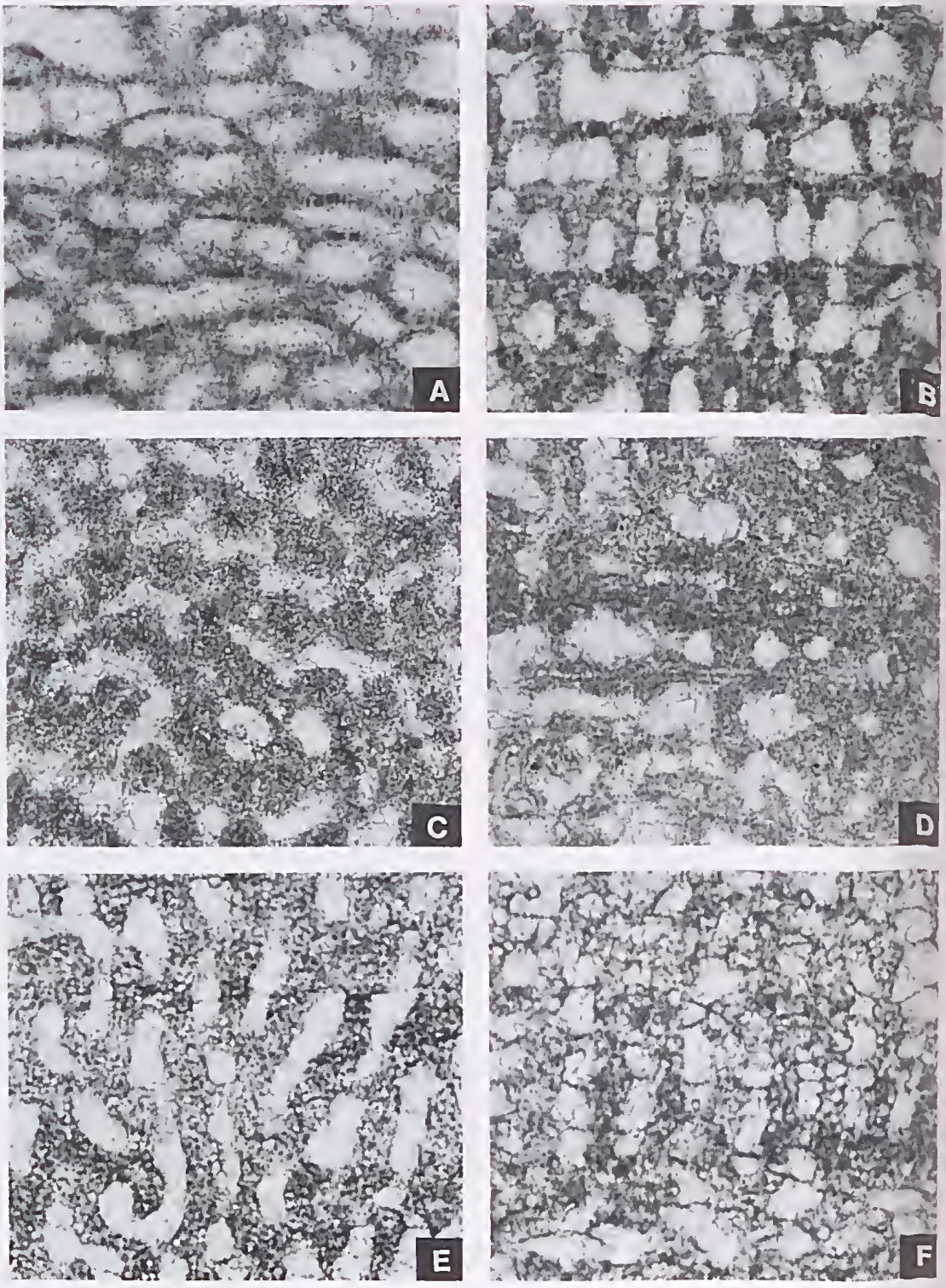
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processes; pillars range markedly in thickness, from 0.08 to 0.15 mm, and show a median dark line (0.03 mm wide) between lighter layers with a fibrous microstructure at right angles to the dark line Dissepiments rare in axial canal and gallery spaces.

Remarks. '*Amphipora ramosa*' has previously been recorded as occurring in the Bell Point Limestone, Waratah Bay (Philip 1960), and from the Coopers Creek Limestone at Tyers (Philip 1962). '*Amphipora* biostromes' have also been reported from the Murrindal Limestone of the Buchan area (Teichert & Talent 1958: 10), and a single specimen is known from equivalent strata at Bindi (Philip 1960). These are probably all representatives of *Stellopora* but the Buchan, Bindi and Tyers material requires further study to confirm this and to establish groupings down to species level.

Few described species of *Stellopora* are closely similar to this new species. Forms like the type species, *S. intexta* from the Lower Devonian (Lochkovian) of Salair and the Middle Devonian of the southern Urals, and *S. karmakensis* (Yavorsky, 1957), also from the Lochkovian of Salair and possibly the Middle Devonian of Xinjiang, north-west China (Dong & Wang 1984), bear resemblances, but they have very slightly larger axial canals (0.4 mm in diameter) and overall a slightly finer network of structural elements (pillars and interseeting lateral processes). *S. karmakensis* also lacks continuity of marginal vesicles along the length of the branch.

Two other species may be compared. Both *S. rudis* (Lecompte, 1952) and *S. desquamata* (Lecompte, 1952), the latter formerly a subspecies of *Amphipora ramosa* (see Flügel & Flügel-Kahler 1968: 348), are from the Givetian–Frasnian successions of Belgium. *S. rudis* is also recorded from Givetian–Frasnian units of the Canning Basin, Western Australia (Cockbain 1984), and possibly from the Moravian karst (Frasnian) of the Czech Republic (Zukalová 1971). *S. rudis* differs from the Victorian Bell Point species in having slightly larger branch dimensions (3.0–3.5 mm in diameter) and a larger axial canal (0.5–0.8 mm in diameter). *S. desquamata* shows similar differences, as well as a reduced and less persistent row of marginal vesicles. The Western Australian representatives of *S. rudis* described by Cockbain (1984) similarly have on average larger branch diameters (mean 3.22 mm), larger axial canal diameters (mean 0.70 mm), and overall a slightly coarser network of internal structural elements (pillars and lateral processes).

Significantly, *S. rudis* is most abundant in the platform interior or back reef environments of the Upper Devonian reef complexes in the Canning Basin (Cockbain 1984), and it is likely that similar dominant occurrences like those of *S. porrecta* in the Bell Point Limestone at Waratah Bay are also environmentally diagnostic of the back reef biofacies.

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Drs David J. Holloway and Thomas A. Darragh, and Mr Andrew Sandford (Museum of Victoria) have assisted the authors in many ways during the course of this project, in particular by facilitating arrangements for borrowing the Ripper types and other relevant material, providing us with a series of new catalogue numbers for the material we collected from the field, and answering numerous technical queries relating to the preparation and presentation of this manuscript for the Royal Society of Victoria. Professor John A. Talent and Dr Ruth Mawson (Macquarie University) have provided helpful details on collecting localities in Victoria and advice about Devonian correlations based on their latest conodont biostratigraphic work, and John Talent has kindly reviewed the stratigraphic parts of our text. Professor Carl W. Stock (Alabama) and

Fig. 31. A, *Petridiostroma clarum* (Počta, 1894), NMV P136257 (*ex* NMV P136157), vertical section showing transverse fibrosity, × 30, Murrindal Limestone, Rocky Camp Quarry. B, *Stictostroma* sp., NMV P136291 (*ex* NMV P136172), vertical section showing tripartite microstructure and porous to transversely fibrous overprinting, × 30, Murrindal Limestone, Rocky Camp Quarry. C, D, *Amnestostroma holmesae* sp. nov., × 30, Lilydale Limestone, Mitchell's (Cave Hill) Quarry, Lilydale; C, paratype NMV P141976 (*ex* NMV P13776), tangential section showing pillars composed of finely cellular skeletal material; D, holotype NMV P141861 (*ex* MUGD 1619), vertical section showing tripartite laminae. E, *Salairella lilydalensis* (Ripper, 1937a), NMV P136311 (*ex* NMV P136216), vertical section showing fine cellular skeletal material, × 30, Coopers Creek Limestone, Tyers Quarry. F, *Parallelopora ampla* sp. nov., holotype NMV P136313 (*ex* NMV P136217), vertical section showing coarsely cellular skeletal material, × 30, Murrindal Limestone, Rocky Camp Quarry.

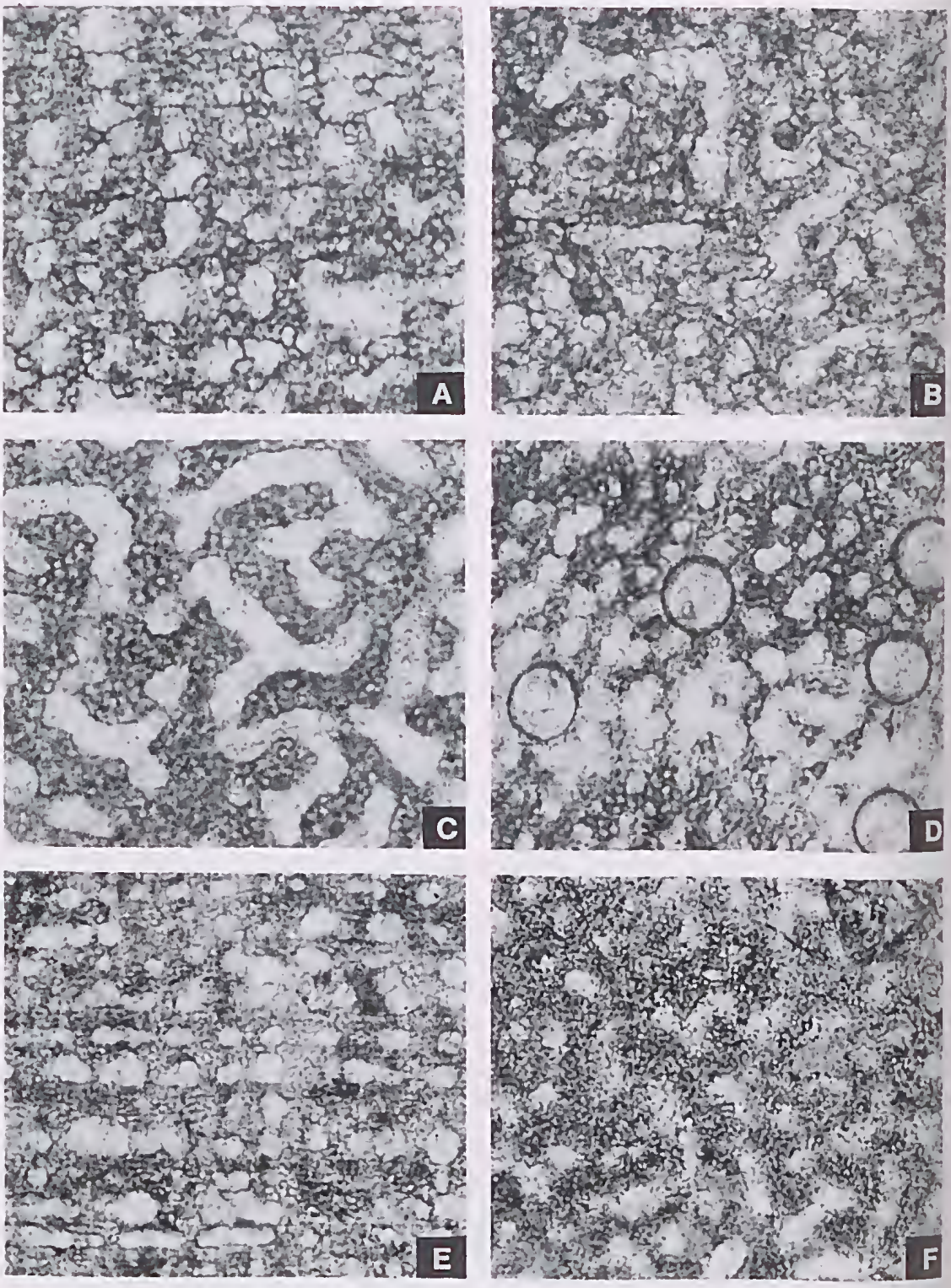
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Fig. 32. A, B, *Parallelopora ampla* sp. nov., holotype NMV P136313 (*ex* NMV P136217), vertical and tangential sections showing coarse cellular skeletal material, × 30, Murrindal Limestone, Rocky Camp Quarry. C, *Syringostromella* cf. *labyrinthea* Stearn, 1990, NMV P141784 (*ex* MUGD 1615), tangential section showing cellular microstructure, × 30, Buchan Caves Limestone, Heath's Quarry. D, E, *Habrostroma tyersense* sp. nov., × 30, Coopers Creek Limestone, Tyers Quarry; D, NMV P136361 (*ex* NMV P136193), tangential section; E, holotype NMV P136342 (*ex* NMV P136185), vertical section showing cellular (microreticulate) microstructure. F, *Columnostroma clathratum* sp. nov., paratype A NMV P141933 (*ex* NMV P13791), tangential section showing fine cellular skeletal material, × 30, Lilydale Limestone, Mitchell's (Cave Hill) Quarry, Lilydale.

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